

Herb Profile: Copalchi/Hintonia • Elderberry & Respiratory Symptoms • 2018 Herb Market Report
FairWild *Terminalia*/Hornbill Project • Blockchain for the Herbal Supply Chain

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Herb Profile: Copalchi/Hintonia • Elderberry & Respiratory Symptoms • 2018 Herb Market Report • FairWild *Terminalia*/Horn Bill Project • Blockchain for the Herbal Supply Chain
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Ruby walks amid towering Mullein stalks during the harvest on our Certified Organic farms in southern Oregon.



dear reader

Consumers continue to want greater transparency and tend to purchase products from companies that exercise an increased level of openness about policies, practices, and so on. The recent emergence of blockchain technology may help. This digital platform allows for a significant degree of transparency and verification at each step of the supply chain, and it is being implemented and promoted in the herbal products industry to enhance and maintain trust in these products. Presumably (and hopefully), this technology can verify how plant materials are collected, grown, processed, traded, and developed into botanical products. ABC contributor Karen Raterman has written an extensive

article on blockchain technology for this issue, so readers can better understand this emerging trend, which is being heralded as a key tool for the development of transparent and sustainable herb industry practices.

Our coverage of conservation and sustainability continues with ABC Assistant Editor Connor Yearsley's article about a FairWild Standard implementation project in the Western Ghats mountains of India. For local people in this biodiversity hotspot, sustainably harvesting the FairWild-certified fruits of *Terminalia bellirica* and *T. chebula*, two of the three ingredients of Ayurveda's *triphala* formula, has provided a better alternative to logging. Importantly, because these people adopted good harvesting practices, they gained access to the global marketplace, where the fruits are more valued than they are locally. Another positive side effect is the preservation of the nesting and roosting sites of two rare hornbill species, both of which may eat the *Terminalia* fruits and disperse the seeds. This project therefore reflects the potential conservation, socioeconomic, and ecological benefits of the standard.

This issue's Herb Profile focuses on *copalchi* (*Hintonia latiflora*), also known as hintonia, a tree whose bark has been used in Mexican traditional medicine. Regular contributors Josef Brinckmann and Thomas Brendler have combed through traditional literature and modern clinical research to provide an overview of this interesting medicinal tree, which is becoming known for its blood sugar-normalizing and antidiabetic properties.

In issue 120, we presented a 12-page, photo-filled report from our "medicine-hunting" friend Chris Kilham about his travels in the Peruvian Amazon. Chris has initiated what may be the most rigorous attempts to document the sustainability of the ayahuasca vine, which has become increasingly popular as the key ingredient in a plant mixture used by indigenous shamans and others as a religious, spiritual, and healing brew. Increased demand for ayahuasca in the United States and elsewhere has prompted Chris to continue to interview people who are involved in harvesting, distributing, and using the vine, to determine current and future supply levels. As part of our continuing coverage of sustainability topics, this issue contains another installment from Chris on this subject.

In our memorial section, we reluctantly bid adieu to two old friends and colleagues. Alan Richman was the editor of *WholeFoods Magazine* (no relation to Whole Foods Market) in the 1980s and '90s when I was a monthly columnist writing about herbs and recent developments in the herb community. Alan stayed active in the natural products industry and extended community for many years after he left the magazine. A consummate professional journalist, Alan was also a kind and decent man whose commitment to communicating about and promoting natural foods, products, and health was more than just a job for him. He truly believed in the superiority and benefits of the natural world.

We also are saddened by the passing of Art Tucker, PhD, a botanist, taxonomist, expert on culinary and aromatic plants, co-author of several herb books, artist, master of many witticisms, and longtime member of the ABC Advisory Board. Art was the co-founder and co-director of the herbarium at Delaware State University and co-author of the feature article in *HerbalGram* issue 100 about the mysterious Voynich Manuscript. At the bottom of his emails, he always appended various botany and science-oriented aphorisms, such as this one, which is one of his originals: "Unvouchered plant research is about as memorable as Whistler's father." HG

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By Connor Yearsley

A case study in the biodiverse Western Ghats mountains of India is demonstrating the potential conservation, socioeconomic, and ecological benefits of the FairWild Standard, a voluntary sustainability standard for the wild collection of medicinal and aromatic plants. For the local people, sustainably harvesting the FairWild-certified fruits of *Terminalia bellirica* and *T. chebula* has provided a better alternative to logging. The project also helps protect the nesting/roosting sites of two rare hornbill species, both of which may eat the *Terminalia* fruits and disperse the seeds. This article includes a Q&A with Josef Brinckmann, an expert on the FairWild Standard, and discusses the standard's benefits and viability.

Belleric myrobalan *Terminalia bellirica*. Photo ©2019 Jayant Sarnaik

52 The Potential of Blockchain for Herbal Supply Chain Management

By Karen Raterman

Blockchain is an emerging technology with great potential for use in managing the herbal supply chain, allowing supplement manufacturers to have greater transparency and traceability from farm to finished product. However, this technology is still developing and requires a greater understanding from stakeholders as to its potential uses and benefits. This article examines multiple perspectives on blockchain technology and unravels the technical intricacy behind it.

62 Herbal Supplement Sales in US Increase by 9.4% in 2018

By Tyler Smith, Michelle Gillespie, Veronica Eckl, Jake Knepper, and Claire Morton Reynolds

This year's *HerbalGram* Herb Market Report describes the continued record growth of retail sales of herbal supplements in the United States, with total consumer spending on these products in 2018 reaching an all-time high: an estimated \$8.842 billion, according to the *Nutrition Business Journal* (NBJ). Total sales increased by 9.4% from 2017, according to NBJ estimates, which is the highest percent sales increase in two decades. NBJ and SPINS, a market research firm based in Chicago, Illinois, provided the data featured in this report, which include sales estimates broken down by retail market channel, product type, and individual herb- and fungi-based dietary supplements.



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On the Cover

All photos ©2019 Steven Foster unless otherwise noted.

Clockwise from top left:

Ginger *Zingiber officinale*

Garlic *Allium sativum*

Turmeric *Curcuma longa*

Fenugreek *Trigonella foenum-graecum*

Flax *Linum usitatissimum*

Milk thistle *Silybum marianum*

Lion's mane *Hericium erinaceus* (Photo ©2019 Lebrac)

Echinacea *Echinacea purpurea*

Center background image:

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Copalchi/Hintonia

Hintonia latiflora

Family: Rubiaceae

By Josef Brinckmann and Thomas Brendler

INTRODUCTION

A rare but ecologically, economically, and medicinally important species,¹ *Hintonia latiflora* is a very slow-growing shrub or small tree that belongs to the madder family (Rubiaceae). It ranges from two to 12 m (6.6 to 39.4 ft) in height² and has pendant, white flowers.³ *Hintonia latiflora* was known formerly as *Coutarea latiflora*, *C. pterosperma*, and *Portlandia pterosperma*,⁴ and all three names are now considered synonyms.⁵

The genus *Hintonia* includes three (or four, depending on the literature) species: *H. latiflora*, native to tropical deciduous dry forest areas extending from parts of coastal northwestern Mexico and south to Central America, including El Salvador and Guatemala⁶; *H. lumaeana*, from southeastern Mexico (e.g., state of Veracruz) to Central America,⁶ possibly also cultivated in forests of Guatemala⁷; and *H. octomera*, endemic to the Yucatán Peninsula of Mexico and parts of Guatemala. Regarding a possible fourth species, while *The Plant List* considers *H. standleyana* to be a synonym of *H. latiflora*, other literature distinguishes these as separate species.^{7,8}

Taxonomic and nomenclatural confusion can arise because, in Mexico, *H. latiflora* has been lumped together in a group of up to 26 species that are from different families and share the vernacular name *quina* (meaning “cinchona”) as part of a “cinchona complex” due to similar morphology and therapeutic uses of the tree barks.⁹ *Hintonia latiflora* is known as *quina amarilla* (“yellow cinchona”),¹⁰ *campanillo*,¹¹ and *copalquín*,¹² among other names, but is more commonly referred to as *copalchi*, which is the name used in the *Mexican Herbal Pharmacopoeia (Farmacopea Herbolaria de los Estados Unidos Mexicanos)*⁴ and listed in the second edition of the American Herbal Products Association’s *Herbs of Commerce*.¹³ Adding to the confusion, a recent paper by Cristians et al. (2018) refers to the “Copalchi Medicinal Plant Complex,” which consists of three

distinct species, *H. latiflora*, *H. standleyana*, and *Exostema caribaeum* (Rubiaceae), that are traded under the same vernacular name copalchi and all “widely used in Mexico for treating diabetes and gastrointestinal disorders.”⁸ Copalchi is also used as a trade name for *Coutarea hexandra* (Rubiaceae) and *Croton niveus* (Euphorbiaceae).¹⁴ Furthermore, the copalchi that is the subject of this article should not be confused with other Mesoamerican “copals” such as *Bursera bipinnata* (Burseraceae), which is known as *copalli* in the Aztec Náhuatl language.¹⁵

The commercial supply of copalchi bark is obtained from wild collection in managed wilderness areas of Guatemala and Mexico. In Mexico, the main harvesting areas include the northern part of Guerrero state in southwestern Mexico⁶ and parts of the neighboring state of Puebla.¹⁰ Copalchi bark is also harvested as a medicinal non-timber forest product in other Mexican states, including the northwestern state of Sonora and the south-central state of Morelos.¹⁶



Copalchi *Hintonia latiflora*
Photo ©2019 Mathias Schmidt

HISTORY AND CULTURAL SIGNIFICANCE

In Uto-Aztec languages, the *H. latiflora* tree is known as *copalquín* in Náhuatl,¹² *tapichogua* in Mayo-Yoreme,¹⁷ and *iwíchuri* in the Rarámuri (also known as Tarahumara) language.¹⁸ The Rarámuri use the bark, drunk as a bitter tea, to treat malaria and fevers, as well as a powder, applied topically, to treat body sores.¹⁸

In 1830, Swiss botanist Augustin Pyramus de Candolle (1778–1841) and son Alphonse de Candolle (1806–1893) named the species *Coutarea latiflora*, which they stated was known as copalchi in Mexico.¹⁹ English botanist Arthur Allman Bullock (1906–1980) established the genus *Hintonia* gen. nov. (*genus novum*, meaning “new genus”) in 1935,²⁰ dedicating it to George Boole Hinton (1882–1943), an English botanist, plant collector, and metallurgist in Mexico,²¹ and segregated it from *Coutarea*, naming four species and one variety: *H. latiflora*, *H. lumaeana*, *H. octomera*, *H. standleyana*, and *H. latiflora* var. *leiantha*.^{20,22}

The first known European account of therapeutic use of *H. latiflora* bark comes from a work compiled from about 1558 through 1577: *Historia general de las cosas de nueva España* (“General history of the things of New Spain”). This 12-book encyclopedia, more commonly referred to as the *Codice Florentino* (“Florentine Codex”), was compiled by Franciscan missionary Fray Bernardino de Sahagún (1499–1590).²³ Sahagún’s codex documented the world of the Nahuas people.²⁴ The work was confiscated by royal decree in 1577, but in 1585 appeared in another publication: *Arte adivinatoria de los mexicanos* (“Mexican divinatory art”).²⁵ Various versions were recopied and distributed by different publishers over the centuries.²⁶

The first shipment of copalchi to the port of Hamburg, Germany, may have been in 1817. It was labeled as *Cascarille de la Trinité de Cuba* (“cascarilla bark of Trinidad, Cuba”), but was later determined to be a type of copalchi bark from Mexico, possibly sourced from either *Croton pseudochina* or *Strychnos pseudoquina* (Loganiaceae). The latter, however, was also confused with *Coutarea latiflora* (now *H. latiflora*) at the time. Thus, the botanical identity of the first shipments of copalchi to Germany remains uncertain.²⁷

A monograph for copalchi first appeared in 1874 in the first edition of the *Nueva Farmacopea Mexicana* (“New Mexican Pharmacopoeia”), albeit with taxonomic uncertainty. Several Latin binomials were included in the monograph description, including *Coutarea latiflora*, *Croton niveus*, *Croton pseudochina*, and *Hedwigia balsamifera* (Hedwigiaceae).²⁸ In other literature, *Croton pseudochina* was referred to as *copalchi de Córdoba* (Veracruz state) and both *Coutarea latiflora* and *Exostema caribaeum* as *copalchi de Jujutla* (El Salvador), although the latter also was described as *corteza*



de falsa quina (“false cinchona bark”).²⁹ In a subsequent review of the

New Mexican Pharmacopoeia *materia medica*, published in the *American Journal of Pharmacy* in 1885, copalchi was described as the bitter bark of various trees, but most commonly that of *Croton niveus* and *C. pseudochina*. The review noted that the latter was often confounded with *C. niveus*, as well as with barks of *Coutarea latiflora*, known as “copalchi of Guadalajara” (Jalisco state), and *H. balsamifera*, known as “copalchi of Orizaba” (Veracruz state).³⁰

Founded in 1923, the Mexican pharmaceutical company Laboratorio Químico Central, S.A. Garcol (Mexico City) manufactured herbal medicinal products under the Garcol brand, named after owner and pharmacist Guillermo García Colín.³¹ One of their products, Glucolisina Garcol, contained extracts of the barks of *H. latiflora* and *Tecoma mollis* (Bignoniaceae) or *T. tronadora*. The product was indicated as an oral hypoglycemic drug for supportive therapy in diabetes.³² By 1950, studies on *H. latiflora* bark extract as an antidiabetic agent appeared in the German medical literature. In the early 1950s, a *H. latiflora*-extract-contain-

Copalchi *Hintonia latiflora* specimen. Image courtesy of Smithsonian Labs.

ing product called Sucontral® was produced and launched in Germany by Curarina-Laboratorium (Stuttgart, Germany), a company that later merged into Harras Pharma Curarina Arzneimittel GmbH (Munich, Germany). More than 60 years later, Harras Pharma continues to market the product in Germany.³³ Sucontral is also marketed in the United States and Canada by EuroMedica and EuroPharma (Green Bay, Wisconsin).

In 2001, copalchi bark was listed only in Annex 2 of the first edition of the *Mexican Herbal Pharmacopoeia* as a medicinal plant with ethnobotanical uses in Mexico, such as for treating stomach pain, malaria, and diabetes.³⁴ In 2013, a full quality standards monograph for copalchi bark specifications entered the second edition of the *Mexican Herbal Pharmacopoeia*.⁴

CURRENT AUTHORIZED USES IN COSMETICS, FOODS, AND MEDICINES

In Mexico, copalchi is used as an active ingredient of registered *remedios herbolarios* (“traditional herbal medicinal products”). Quality of the botanical raw material should conform with the monograph of the *Mexican Herbal Pharmacopoeia*. Copalchi may be a monopreparation but also found in traditional formulations such as in the registered product Latixcol® (VertPharma; Mexico City, Mexico). The product contains extracts of copalchi bark, cuachalalate (*Amphipterygium adstringens*, Anacardiaceae) bark, and simonillo (*Conyza filaginoides*, Asteraceae) herb and is indicated for digestive disorders and abdominal pain.³⁵

In Canada, copalchi bark is regulated as an active ingredient of licensed natural health products (NHPs), which require pre-marketing authorization from the Natural and Non-prescription Health Products Directorate (NNHPD). At the time of writing (June 2019), there was just one licensed NHP listing *Hintonia latiflora* as an active ingredient: Sucontral D, which contains a dry extract of *H. latiflora* bark, with a drug-to-extract ratio (DER) range of 2-4:1 (w/w) and content of 6% coutareagenin, in combination with biotin, chromium, folate, and other micronutrients, with the authorized use “provides support for healthy glucose metabolism.”³⁶ In the EU, there is also one product, Sucontral D, which recently transitioned from being a licensed herbal medicinal product to the category of foods prepared for particular nutritional purposes (PARNUTS).

In the United States, copalchi bark may be used as a component of dietary supplement products, which require a notification with the US Food and Drug Administration within 30 days of marketing if a structure-function claim is made.³⁷

MODERN RESEARCH

Scientific research investigating the composition and mode of action of copalchi began near the end of the 19th century at the Instituto Médico Nacional (IMN) in Mexico City. The first clinical investigations are also reported from around that time. However, with only one product in the market (Sucontral D), clinical data remain sparse. The first

“modern” clinical investigation was likely an observational trial reported by Machens in 1992.³⁸

Paris and Bastien (1960) first isolated a neoflavonoid glucoside, coutareoside,³⁹ from copalchi bark, which was strongly hypoglycemic.^{40,41} Reguero et al. (1987)⁴² and Mata et al. (1990)⁴³ further investigated the biochemical composition of copalchi bark and reported the presence of cucurbitacins and other secondary metabolites. Hager (2006) lists polyphenolic substances and triterpenes as the primary active constituents of copalchi bark, the former group dominated by the presence of neoflavonoids (mainly 4-phenylcoumarins) and neoflavonoid glycosides, as well as flavones, flavonols, and phenolcarboxylic acids; and the latter group (triterpenes) consisting of mainly cucurbitacins.¹⁴ The copalchi monograph in the *Mexican Herbal Pharmacopoeia* requires the dried bark to contain minimum 6.4% of phenylcoumarin derivatives.⁴

From 1890 to 1913, the stem bark of *H. latiflora* was subjected to pharmacological investigations at the IMN.⁴⁴⁻⁴⁸ These studies included the isolation of a glycoside (called “coutareoside”) that was later rediscovered by German and French researchers. The compound was devoid of toxic effects and provoked diuresis and an increase in the body weight of the patients. Most importantly, Landa (1913) demonstrated the hypoglycemic properties of an extract of the plant and of the glycosidic constituent.⁴⁶ Kaiser and Geyer were the first to introduce copalchi bark to an international scientific audience.⁴⁹⁻⁵¹ Kaiser and Geyer (1955),⁵¹ Paris and Bastien (1960),³⁹ and Bastien (1961)⁵² confirmed the blood sugar-lowering effect of copalchi bark in a rabbit model as well as its low toxicity in mice and guinea pigs. A few years later, Sucontral was introduced in the German market by Curarina-Laboratorium, Stuttgart, and the first case reports and observational trials of its efficacy were published.⁵³⁻⁵⁸

A significant decrease in blood sugar after oral administration of Sucontral to diabetic mice also was demonstrated by Slijepčević and Kraus (1997).⁵⁹ A study by Korec et al. (2000)⁶⁰ confirmed the antidiabetic effect of the neoflavonoid coutareagenin from *H. latiflora* bark in streptozotocin-induced diabetes in rats. A vasodilative effect of Sucontral, which supports its antidiabetic effect, was described by Vierling (2005)³³ and Vierling et al. (2014).⁶¹ According to Cristians et al. (2018),⁸ the 4-phenylcoumarins and chlorogenic acid prevent depletion of endogenous sulfhydryl groups, which are important for the preservation of gastric mucosal integrity, a mechanism of action that may support the gastroprotective efficacy of the aqueous extract of the bark.

Noster and Kraus (1990)⁶² reported significant antimalarial activity of a hydrolyzed ethyl acetate extract of copalchi bark. A recently published review by Rivero-Cruz et al. (2019)⁴⁸ summarized findings that support copalchi bark’s antinociceptive and antimicrobial effects in addition to its antidiabetic, vasodilative, and gastroprotective effects. Unpublished studies by Slijepčević and Kraus (1986)⁶³ and Westendorf and Kraus (1987)⁶⁴ investigated acute, chronic, and genotoxicity of copalchi bark. No negative outcomes

were reported.³⁸ Rivero-Cruz et al. (2019)⁴⁸ also summarized toxicological findings: They report an LD₅₀ (median lethal dose) for *H. latiflora* organic solvent extract at 2.9 g/kg and no mutagenic effects (no solvent or animal model provided). Déciga-Campos et al. (2007)⁶⁵ found no toxicity in mice for aqueous stem bark extracts, and Garcia (2010)⁶⁶ reported no histological damage in chronic toxicity models with rats. On the other hand, Rivera et al. (2014)⁶⁷ and Flores-Jiménez et al. (2018)⁶⁸ reported a battery of toxic effects of a methanolic extract of *H. latiflora* stem bark in mice in a dose-dependent manner.⁴⁸

According to the Diabetes Canada Clinical Practice Guidelines Expert Committee, dry extract of *H. latiflora* bark, an NHP for treatment of co-morbidities and complications of diabetes, has been shown to be able to lower glycated

hemoglobin (A1C) by at least 0.5% in adults with type 2 diabetes.⁶⁹ The expert committee cited a clinical study that concluded that there was a positive effect of a dry extract of *H. latiflora* bark (extraction solvent ethanol 32%; DER 2.4:1) on blood glucose levels, suggesting a potential benefit in the management of type 2 diabetes.⁷⁰

All clinical investigations in Table 1 were conducted with Sucontral, a liquid ethanolic extract of the bark of *H. latiflora* (extraction solvent ethanol 32%; DER 1:4.5).

ADULTERATION AND SUBSTITUTION

Adulteration or substitution of copalchi bark with barks of other Mexican plants that are traded under the same vernacular name(s) — including other *Hintonia* species, *Coutarea hexandra*, *Croton niveus*,¹⁴ *Exostema*

Table 1. Clinical Trials with Copalchi/Hintonia Bark Extract

Publication	Study Design	Interventions	Outcome
Ritzmann (1950) ⁵³	Case report, diabetic subjects, n=16	Sucontral®, 3x 30 drops for four months	Significant reduction of glucose in blood and urine, especially in less severe cases of diabetes; reduction of 24-hour urine volume; improvement in quality of life; no adverse events
Vida (1951) ⁵⁶	Case report, diabetic subjects, n=26	Sucontral, 3x 30-50 drops for 6-8 days	Significant reduction of glucose in blood and urine, especially in less severe cases of diabetes (13 of 26)
Winter (1951) ⁵⁷	Case report, diabetic subjects, n=2	Sucontral, 3x 30 drops, open ended	Significant reduction of glucose in blood and urine within four weeks; secondary symptoms (itching, thirst, furunculosis) remained in remission
Kuhr (1953) ⁵⁸	Observational study, healthy subjects (n=10), subjects with age-related moderate diabetes (n=15)	Healthy subjects: Sucontral, 50 drops/day plus insulin, 5 units/day for three days; Diabetic subjects: 3x 30-50 drops for six weeks	No effect of Sucontral on blood glucose levels in healthy subjects; Sucontral allowed for reduction of insulin dose, while glucose levels in blood and urine decreased and secondary symptoms improved in patients with diabetes
Machens (1992) ³⁸	Observational study, diabetic subjects, n=16	Sucontral, 2x 10 drops, and glibenclamide, open ended, 3+ years	Glycosylated hemoglobin (HbA1c) levels decreased significantly in nine of 16 cases
Ploss (2002) ⁷¹	Case report, type 2 diabetic subject, n=1	Sucontral, 5x 50 drops for eight weeks	Reduction of fasting blood glucose levels from 191 mg/% to 176 mg/%
Korecova et al. (2006) ⁷²	Observational study, type 2 diabetic subjects, n=30	Sucontral, 3x 2 mL for a minimum of 12 months (total study duration 33 months)	HbA1c levels significantly reduced after three months and stable after that; liver parameters stable; total cholesterol decreased slightly; triglycerides decreased significantly; secondary symptoms (neuropathy, sweating, etc.) reduced after three months
Korecova & Hladikova (2014) ⁷⁰	Observational study, type 2 diabetic subjects, n=41, 9 terminations	Sucontral D*, 2x one capsule for six months	HbA1c levels and fasting and postprandial glucose levels significantly reduced; good tolerance; lipid values positively affected

* 100 mg of a dry concentrate per capsule (DER 2.4:1, solvent 32% ethanol); capsules also contained 30 mg vitamin C, 5 mg vitamin E, 0.7 mg vitamin B1, 0.8 mg vitamin B2, 1 mg vitamin B6, 0.5 µg vitamin B12, 100 µg folic acid, 75 µg biotin, 2.5 mg zinc, and 25 µg chromium.

caribaeum, and/or the leaves of *H. latiflora* — has been reported.⁸ Because aqueous infusions of *H. latiflora* and *H. standleyana* are used interchangeably in traditional Mexican medicine, a high-performance liquid chromatography (HPLC)-UV method for quantitative determination of the major antihyperglycemic 4-phenylcoumarins of each species was developed. Fingerprint chromatograms have been established for routine identification testing of both species.⁷³ While the copalchi bark monograph of the *Mexican Herbal Pharmacopoeia* provides thin-layer chromatography (TLC) and HPLC methods for identity testing, the monograph provides no methodology for differentiating the official species from *H. standleyana* and *E. caribaeum*, nor from the leaves of *H. latiflora*.

Economically motivated adulteration with the wrong plant part or other species is foreseeable due to increasing demand for the authentic tree bark. Recent studies have shown that the use of chemical marker compounds alone may not confirm the identity of the botanical raw material, in the event that adulterants are admixed. It has been recommended that the *Mexican Herbal Pharmacopoeia* consider that concomitant use of DNA molecular markers may be necessary.⁸

SUSTAINABILITY AND FUTURE OUTLOOK

The conservation status of *H. latiflora* has not yet been assessed using the International Union for Conservation of Nature (IUCN) *Red List Categories and Criteria*. The main threat to wild populations of *H. latiflora* has been harvesting intensity (overharvesting) and careless/destructive harvesting practices. Reportedly, forest management regulations are in place in Mexico and are supposed to manage the harvest and sustainable trade of *H. latiflora*.⁶

Debarking practices have been observed to modify the shape and size of *H. latiflora* trees.¹ According to Cristians et al. (2018), all species in the copalchi complex (*H. latiflora*, *H. standleyana*, and *E. caribaeum*) are facing considerable pressure, because they are all widely used in Mexico for treating diabetes, and the entire supply for pharmaceutical drug production is obtained from wild populations.⁸ A recent risk study of wild medicinal plants traded in the Balsas River Basin area, a major source of wild Mexican medicinal plants, ranked *H. latiflora* as the third most endangered species (out of 231 species evaluated). The aforementioned *A. adstringens*, whose bark is sometimes used in combination with copalchi bark, ranked as the most endangered species in the region.⁷⁴ According to a Oaxaca case study, both *A. adstringens* and *H. latiflora* reportedly have declined in abundance, which is attributed to over-exploitation of individual trees for bark extraction.⁷⁵

With an increase in the mortality rate for type 2 diabetes patients in recent decades, Mexico now ranks sixth in world prevalence of diabetes.⁷⁶ If new clinical data continue to strengthen the evidence of safety and efficacy of copalchi preparations to manage conditions associated with diabetes, strains on the wild copalchi populations in Mexico would predictably increase.

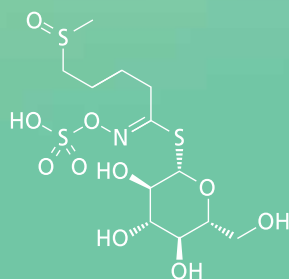
So far, there is low visibility of copalchi ingredients coming to market with documented evidence of sustainable wild collection and trade, for example based on independent third-party inspection and certification demonstrating compliance with the US Department of Agriculture's (USDA's) organic wild-crop harvesting practice standard⁷⁷ or the FairWild Foundation's FairWild Standard.⁷⁸ In Guatemala, *H. latiflora* reportedly is wild collected under supervision in a managed wilderness area to supply one international brand, Sucontral (C. Myers [EuroPharma] email to T. Smith, June 29, 2019). Increased harvesting of copalchi tree bark to support growing domestic and international demand for antidiabetic medications may necessitate biodiversity conservation and forest management for future access to this medicinally important genetic resource of Mexico.⁷⁹ Restoration programs in areas impacted by commercial harvesting of copalchi bark have been proposed. This method of forest replenishment would aim to ensure establishment of individual trees with desirable characteristics for bark harvesting.¹



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Natural fostering, as proposed, should contribute to in-situ conservation (i.e., “the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings”).⁸⁰ HG

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ADOPT-AN-HERB

HerbMedPro™

P R O G R A M

The American Botanical Council's Adopt-an-Herb Program provides a mutually beneficial opportunity to support ABC's nonprofit educational efforts and promote a company's most important herbs.

One of the benefits of supporting the Adopt-an-Herb Program is that it ensures that the most current information on the adopted herb is available through ABC's powerful HerbMedPro™ database.

HerbMedPro provides online access to abstracts of scientific and clinical publications on more than 250 commonly used medicinal herbs. A free version, HerbMed®, is available to the general public and includes access to adopted herbs. HerbMedPro is available as a member benefit to all ABC members at the Academic Membership level and up.

In addition to ensuring that recently published information on an adopted herb is up to date on HerbMedPro, another benefit adopters enjoy is being included among their peers in each issue of ABC's acclaimed quarterly, peer-reviewed scientific journal, *HerbalGram*, on the ABC website, and at scientific, medical, and other educational conferences. Press releases also are issued on new adoptions, bringing attention to the program, the adopted herb, and the adopting company. Each adopted herb is featured on its own page on the ABC website.

Parties interested in taking part in the Adopt-an-Herb Program are invited to contact ABC Development Director Denise Meikel at 512-926-4900, extension 120, or by email at denise@herbalgram.org.




























Herbal Adopters

	Milk Thistle <i>Silybum marianum</i>		Senna <i>Senna alexandrina</i>
	Fig <i>Ficus carica</i>		Black Chokeberry <i>Aronia melanocarpa</i>
	Yerba Maté <i>Ilex paraguariensis</i>		Elderberry <i>Sambucus nigra</i>
	Helichrysum <i>Helichrysum italicum</i>		Stinging Nettle <i>Urtica dioica</i>
	Saffron <i>Crocus sativus</i>		Echinacea <i>Echinacea spp.</i>
	Cayenne <i>Capsicum annuum</i>		Purple Corn <i>Zea mays</i>
	EpiCor® Fermentate <i>Saccharomyces cerevisiae</i>		Lemon Balm <i>Melissa officinalis</i>
	Rhodiola <i>Rhodiola rosea</i>		Bulbine <i>Bulbine natalensis</i>
	Garlic <i>Allium sativum</i>		Broccoli <i>Brassica oleracea Broccoli Group</i>
	Artichoke <i>Cynara cardunculus Scolymus Group</i>		Tea Tree <i>Melaleuca alternifolia</i>
YOUR LOGO	Baobab <i>Adansonia digitata</i>		Peppermint <i>Mentha x piperita</i>
YOUR LOGO	Rooibos <i>Aspalathus linearis</i>	Plant name <i>Scientific name</i>	Aloe Vera <i>Aloe vera</i>
YOUR LOGO	Propolis	YOUR LOGO	Maca <i>Lepidium meyenii</i>
YOUR LOGO	Plant name <i>Scientific name</i>	YOUR LOGO	Plant name <i>Scientific name</i>

Visit us at www.herbalgram.org/adopt

Contact Denise Meikel at 512-926-4900 x120
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Herbal Adopters

 Ginseng Plus®	NEW ADOPTER! Notoginseng <i>Panax notoginseng</i>	 BRAUER natural medicine	NEW ADOPTER! Chamomile <i>Matricaria chamomilla</i>
 FAR LONG	NEW ADOPTER! Lifeflower <i>Erigeron breviscapus</i>	 grownetwork™	NEW ADOPTER! Rough Horsetail <i>Equisetum hyemale</i>
 BOTALYS Better plants for a better Life	Asian Ginseng <i>Panax ginseng</i>	 natural™ REMEDIES	Licorice <i>Glycyrrhiza spp.</i>
 NAHA	Lavender <i>Lavandula angustifolia</i>	 valensa	Saw Palmetto <i>Serenoa repens</i>
 VERDURE SCIENCES®	Pomegranate <i>Punica granatum</i>	 NATUROPATHICA™ HOLISTIC HEALTH	Arnica <i>Arnica montana</i>
 KSM-66	Ashwagandha <i>Withania somnifera</i>	 FUTURE CEUTICALS	Coffee Fruit <i>Coffea spp.</i>
 RFI FROM FIELD TO FORMULA	Hibiscus <i>Hibiscus sabdariffa</i>	 Teawolf Natural Extract Solutions	Guayusa <i>Ilex guayusa</i>
 SFI	Bacopa <i>Bacopa monnieri</i>	 Gaia Trading Company, Inc.	Hops <i>Humulus lupulus</i>
 Nature's Way	Ginkgo <i>Ginkgo biloba</i>	 THE ACTIVES FACTORY	Birch <i>Betula spp.</i>
 biotropics MALAYSIA	Kesum <i>Persicaria minor</i>	 Natac Science to Market	Olive <i>Olea europaea</i>
 layn USA	Tongkat Ali <i>Eurycoma longifolia</i>	 Pharmatoka	Grape <i>Vitis vinifera</i>
 travel medic www.travelmedic.com	Monk Fruit <i>Siraitia grosvenorii</i>	 ECOSO DYNAMICS	Cranberry <i>Vaccinium macrocarpon</i>
 DIANA Performance from nature FOOD	Kratom <i>Mitragyna speciosa</i>	 Terry Naturally EuroPharma	Devil's Claw <i>Harpagophytum spp.</i>
 Zembrin	Acerola <i>Malpighia spp.</i>	 YOUR LOGO	Turmeric <i>Curcuma longa</i>
	Sceletium <i>Sceletium tortuosum</i>		Plant name <i>Scientific name</i>

Become an adopter today!

Senna, Garlic, and Artichoke Adoptions Support ABC's Adopt-an-Herb Program

By ABC Staff

The American Botanical Council (ABC) recently announced the adoptions of three botanicals through its Adopt-an-Herb research and education program: senna (*Senna alexandrina*, Fabaceae) by K. Patel Phyto Extractions Pvt. Ltd., a Mumbai-based company that specializes in Indian botanical extracts and phytochemicals; and garlic (*Allium sativum*, Amaryllidaceae) and artichoke (*Cynara cardunculus*, Asteraceae) by Neem Biotech, a Wales-based biotechnology company with expertise in bioactive compounds from plants.

These adoptions support ABC's extensive HerbMedPro database, ensuring that this unique research and educational resource remains up to date for researchers, health professionals, industry members, students, consumers, and other members of the herbal and dietary supplement and natural medicine communities. HerbMedPro is a comprehensive, interactive online database that provides access to important scientific and clinical research data on the uses and health effects of more than 265 herbs, spices, medicinal plants, and fungi.

K. Patel Phyto Extractions Adopts Senna

"Through the Adopt-an-Herb initiative, we are proud to be a part of maintaining the database about senna and contribute to sharing information and knowledge about senna," said Viraj Patel, director of business development for K. Patel Phyto Extractions.

ABC Founder and Executive Director Mark Blumenthal said: "ABC is deeply grateful for the adoption of senna by K. Patel Phyto Extractions. Senna is an ancient herbal drug, the medicinal properties of which have been recognized for millennia, including in official pharmacopeial monographs. Even today, senna extracts, and the sennosides found in senna leaf and fruit are approved by various government agencies and pharmacopeias as safe and effective stimulant laxatives."

Blumenthal added: "The K. Patel adoption of senna on ABC's HerbMedPro database will ensure that new scientific and clinical research on this classic medicinal plant will be more available to researchers, health professionals, industry members, and other stakeholders in the international medicinal plant community."

About Senna

Native to tropical areas of Africa, the Arabian Peninsula, and India, senna is a drought-tolerant shrub that typically reaches 1 to 2 meters (3.3 to 6.6 feet) in height. The plant has small yellow flowers, branching stems that taper to a point, and compound leaves

with four to eight pairs of leaflets that form sharp edges. These features likely explain the plant's common name, which comes from the Arabic word *sanaa*, meaning "thorny bush."

ADOPT-AN-HERB
HerbMedPro™ PROGRAM



Senna *Senna alexandrina*
Photo ©2019 Steven Foster



Authentic Botanical Extracts

Senna

Senna alexandrina

Senna has been used in traditional medicine systems of Asia for centuries. Ninth-century Syriac physician Serapion the Elder is believed to have been one of the first to recommend senna for use as a medicine. In Ayurvedic medicine, senna leaf formulations such as tea preparations are used to treat constipation and digestive diseases. Similarly, senna leaf is used in traditional Chinese medicine to treat excessive heat associated with constipation and abdominal pain.

Senna still is used primarily for its laxative properties. In the United States, senna is approved as an ingredient in over-the-counter (OTC) products for the treatment of constipation and irregularity. Modern research has examined the use of senna preparations — particularly the plant's dianthrone glycosides sennoside A and B — for chronic constipation, medication-induced constipation, and colonoscopy preparation. Results from human clinical trials suggest that senna preparations are useful for these conditions.

About K. Patel Phyto Extractions Pvt. Ltd.

K. Patel Phyto Extractions Pvt. Ltd. has been in the business of Indian botanical extracts and phytochemicals for more than 14 years. It specializes in manufacturing innovative and quality-driven products, including its flagship senna extract, according to the company. K. Patel Phyto Extractions strives for a sustainable supply chain and runs

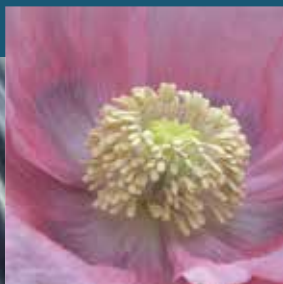
various programs to educate farmers on best agricultural and plant collection practices. The company notes that it operates a state-of-the-art manufacturing facility in Gujarat, India, that produces extracts and phytochemicals that meet the regulatory standards of various countries around the world.

Neem Biotech Adopts Garlic and Artichoke

According to Neem Biotech CEO Graham Dixon, although the company is now more active in mainstream pharmaceutical biotechnology research and development, “Neem Biotech has its roots in extracting bioactive compounds from natural products,” he said. “Neem is pleased that its legacy interest in garlic and artichoke is being continued through the American Botanical Council’s Adopt-An-Herb program to help people live healthier lives through the responsible use of herbs and medicinal plants.”

Blumenthal said: “ABC is deeply grateful to Neem Biotech for its generous adoptions of these two important medicinal herbs on ABC’s HerbMedPro database. Garlic has been one of the most popular herbal dietary supplements in the United States for more than 20 years and is used for a wide variety of clinically documented health benefits, while artichoke extracts are popular in Europe, where they are employed as an aid for various digestive conditions.”

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About Garlic

Native to Central Asia and the eastern Mediterranean, garlic, a member of the amaryllis family, has been used for millennia as food and medicine. The earliest known written record of garlic as a medicine is found in the Ebers Papyrus. This Egyptian medical document, dated to circa 1550 BCE, indicates that garlic bulb was used as a treatment for abnormal growths and abscesses, circula-

tory ailments, general malaise, and parasites. Garlic also was mentioned in the Bible as a source of food and in the Jewish Talmud as an aphrodisiac for married couples. In ancient Greece and Rome, evidence of garlic consumed as a fortifying tonic for athletes and warriors dates back to 1400 BCE. Greek physicians Hippocrates (ca. 460-370 BCE) and Dioscorides (ca. 40-90 CE) both wrote about the use of garlic for circulatory and pulmonary complaints. Garlic also became a staple of Asian medicine in India, China, and Japan as a digestion aid and for its antimicrobial activity.

Currently, garlic is being investigated for its cardiovascular benefits, particularly for lowering blood pressure, blood sugar, and cholesterol levels. Garlic bulb contains organosulfur compounds, which are believed to be partly responsible for its observed hypocholesterolemic and antioxidant effects.

About Artichoke

The artichoke plant is a large, spiny perennial member of the sunflower family that is native to the Mediterranean area and northern Africa. The primary medicinal part of the plant is the leaf, which is often prepared as an extract. Artichoke plants are a good source of the prebiotic fiber inulin, flavonoids, and phytosterols. In addition, artichoke contains sesquiterpene lactones, which give the plant its bitter taste. The first known written record of artichoke is found in the writings of Greek botanist Theophrastus (371-287 BCE), and Roman naturalist Pliny the Elder (23-79 CE) recommended artichoke for intestinal distress. Both the Greeks and the Romans used artichoke as a diuretic and choleric (bile-producing agent that aids digestion). Other traditional uses of artichoke focus on liver health and digestion.

Modern research has shown that artichoke leaf extract supplementation is correlated

	<p>Garlic <i>Allium sativum</i></p>
	<p>Artichoke <i>Cynara cardunculus</i> Scolymus Group</p>



Garlic *Allium sativum*
Photo ©2019 Steven Foster

with lower total cholesterol levels and positive effects on blood lipid composition. Artichoke leaf extract also has beneficial effects on digestive complaints.

About Neem Biotech

Neem Biotech is a Wales-based biotechnology company with a vision to enhance people's life expectancy and quality of life. With significant expertise in the biology and chemistry of bioactive compounds from plants, Neem Biotech transforms these natural compounds into novel, non-traditional treatments that can aid in the fight against the global threat of antimicrobial resistance. The company presently is studying and has drug candidates for the inhibition and treatment of respiratory infections and wounds. For more information, visit www.neembiotech.com.

About Adopt-an-Herb and HerbMedPro

K. Patel Phyto Extractions and Neem Biotech are among the 62 US and international companies that have supported ABC's educational efforts to collect, organize, and disseminate reliable, traditional, and science-based information, including clinical studies, on herbs, medicinal plants, and other botanical- and fungal-based ingredients through the Adopt-an-Herb program. This program encourages companies, organizations, and individuals to "adopt" one or more specific herbs for inclusion and ongoing maintenance in the HerbMedPro database. To date, 69 herbs have been adopted.

Each adopted herb is continuously researched for new scientific articles and botanical, chemical, pharmacological, toxicological, and clinical studies, ensuring that its HerbMedPro record stays current and robust. Access to the studies is conveniently organized by publication type, with each study condensed to a one-sentence summary with a link to the study's official abstract on PubMed (the US National Library of Medicine's free-access database) or other publicly accessible database.

HerbMedPro is available to ABC members at the Academic level and higher. Its "sister" site, HerbMed, is available to the general public at no cost, with access to 25-30 herb records from the larger HerbMedPro database. In keeping with ABC's position as an independent research and education organization, herb adopters do not influence the scientific information that is compiled for their respective adopted herbs. HG



Artichoke *Cynara cardunculus* Scolymus Group
Photo ©2019 Steven Foster

Employee Profile: Sahar Hanrahan

By Hannah Bauman

In January 2019, the American Botanical Council (ABC) hired Sahar Hanrahan as its communications and marketing coordinator. Since then, Hanrahan has breathed new life into the nonprofit organization's social media presence. Instagram (@herbalgramabc) now abounds with photos of the spring and summer blossoms in the gardens of ABC's headquarters, the 2.5-acre Case Mill Homestead, and ABC's Facebook and Twitter pages (@HerbalGram) keep members and followers up to date with timely posts, videos from the Sustainable Herbs Program, and snippets from media interviews and ABC publications such as *HerbalGram*, HerbClip, and Botanical Adulterants Prevention Bulletins.

"I was hired to communicate who ABC is to our members but also to people who don't know us, to help people get a sense of what ABC does and why it's important that we are supported by the larger herbal community and other stakeholders," Hanrahan explained.

Her job involves answering media inquiries, publishing press releases, and updating different social media accounts. "Having access to so much scientific information and research on herbs is really enriching," Hanrahan said. "I think it's important that people are aware of the scientific evidence on beneficial plants."

Born in Alkmaar, the Netherlands, Hanrahan earned a bachelor's degree in communications at Hanze University of Applied Sciences in Groningen, the Netherlands. She gained her first work experience during an internship at the Groningen Forum, an international film house. There, she handled online communications, advertising, website updates, and volunteer management for film festivals. In 2015, she accepted a public relations position for the international Building the Future of Health conference in Groningen, which sought to bring together health care, city planning, and public health to promote healthier aging.

After the conference was held in June 2016, its organizers could no longer employ Hanrahan full time, so she looked elsewhere. With family near Austin, Texas, she relocated to the United States, and, in 2017, began attending the Wildflower School of Botanical Medicine. Learning about herbalism, she said, gave her a renewed sense of purpose and also introduced her to ABC as an organization, since the classes are held in the ABC annex building.

"Spending a lot of time in the garden multiple times a week helped me get to know Austin better and feel more at home because I knew the plant life," Hanrahan said. "So now, everywhere I go, it's like I see familiar faces."

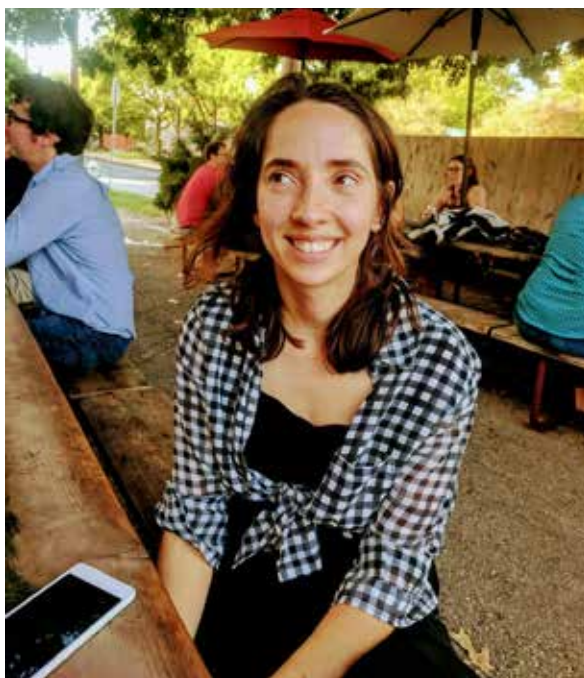
Hanrahan's enthusiasm for herbal studies and background in communications and public relations are vital assets to ABC, and she looks forward to future projects with the organization. She particularly enjoyed working at her first HerbDay, a public event that ABC holds at its headquarters every May to celebrate herbal medicine and promote its educational mission. The biggest change Hanrahan foresees is the update of ABC's extensive website, which she

thinks will be a dynamic tool for future marketing strategies.

Denise Meikel, ABC's development director, welcomed Hanrahan and her talents. "Sahar's been a boon to our communication and marketing efforts," Meikel said. "She's enthusiastic, equally able to be self-directed and a good team player, and filled with creativity and technical knowledge. ABC and Sahar are an excellent fit."

In her free time, Hanrahan enjoys hiking and camping, plant walks, and self-guided ashtanga yoga practice. She also makes her own herbal tinctures and has begun to experiment with plant-based dyes. "Before I moved to the United States, I developed an ulcer from stress," she said. "It taught me to listen better to what my body's saying, and I got into natural ways of healing.... [Studying herbalism] helped me realize this is something I want to focus on. I wanted to work for a nonprofit that's health related and is working on bettering the community that I'm in." HG

"Sahar's been a boon to our communication and marketing efforts. She's enthusiastic, equally able to be self-directed and a good team player, and filled with creativity and technical knowledge. ABC and Sahar are an excellent fit."



Sahar Hanrahan

ABC's Volunteer of the Year: Daniel Elliott

By Connor Yearsley

The American Botanical Council (ABC) recognizes Daniel Elliott as its 2019 volunteer of the year. Elliott, a native of Waco, Texas, is a father, massage therapist, and musician who plays the bass guitar at his church. Almost every Tuesday since May 2018, he has come to ABC's headquarters, the historic 2.5-acre Case Mill Homestead in East Austin, to work in the gardens on the property.

"Basically, I've touched almost every inch of the yard by now," Elliott said with a laugh. Unafraid to get his hands dirty or endure the often-intense Texas heat, he helps maintain the grounds not for monetary compensation, but because he wants to.

Elliott learned about ABC while searching for volunteer opportunities online. At first, he was looking to work with animals but started to find options involving gardening. He thought: "I would like to learn how to garden. It wouldn't hurt..., so that I can start planting my own garden in the backyard, and be self-sustainable, and learn how to grow my own food. I came here and have been here ever since."

Although he had no previous gardening experience, Elliott thinks working with plants makes him a better father to his two-year-old son, Kyree. "Gardening goes hand in hand with life, in a way," Elliott said. "Having a child is life, and then gardening is life." He hopes to one day pass down what he's learned at ABC to Kyree, so he, too, can grow his own food and medicine.

Elliott likes ABC's "nice and chill environment" and has enjoyed learning about the entire process of gardening, from beginning to end, including planting, mulching, and weeding. "Then, as the months go by, you start to see everything start blooming," he said. "It's like seeing the fruits of your labor, which is an interesting thing to see."

For Elliott, the most challenging part has been working in the temperature extremes of Central Texas, but he would recommend the experience to others. "Of course I would pass it on to other people and tell them to come here, because it's a skill that everybody should know," he said. "Why would you not want to know how to grow your own [plants]?"

Elliott plans to maintain a relationship with ABC for as long as he can. "There is no telling what the future holds and how things twist and turn, but for as long as I can go, I'll keep going," he said.

ABC chose Elliott as its volunteer of the year for 2019 because he has logged more than 75 hours with the organization, which is

more than any other volunteer since he started. ABC has not named a volunteer of the year since Clark Dufour in 2013.

Toby Bernal, ABC's head gardener who has helped supervise Elliott, said: "I've had a great time working with him in the garden and admire his commitment to becoming a better father and gardener. He always comes in with a smile and always does a great job." Bernal added that Elliott also has helped with the stone work around some of the garden beds.

Jenny Perez, ABC's education coordinator, said: "Daniel is appreciated for being one of our most consistent garden volunteers, showing up weekly regardless of what the weather was like. Daniel has a warm smile and positive, friendly attitude about life. He never complains about the various garden tasks he helps out with and does a thorough job. Daniel has a strong interest in helping others. During his time volunteering in the gardens at ABC, he has cultivated an interest in herbal medicine and has participated in some of the kitchen medicine lessons that I teach primarily to ABC pharmacy and dietetic interns."

Information about volunteer opportunities at ABC is available at www.herbalgram.org. HG



Daniel Elliott

Aloe Vera Bulletin Published by Botanical Adulterants Prevention Program

New publication documents adulteration of aloe vera leaf gel and juice with undeclared maltodextrin and ingredients from other Aloe species

By ABC Staff

The ABC-AHP-NCNPR Botanical Adulterants Prevention Program (BAPP) has published a new Botanical Adulterants Prevention Bulletin (BAPB) on aloe vera (*Aloe vera*, Asphodelaceae) leaf gel- and juice-derived ingredients. This is the 18th bulletin published by BAPP.

Gel obtained from the leaf of aloe vera, typically in the form of dried powder, is used widely as an ingredient in dietary supplement, personal care, and cosmetic products. In addition, aloe vera leaf juice is a popular ingredient in the food and beverage industry. The total global market value of aloe vera leaf gel (as an ingredient in all product types)

was estimated to be \$507 million in 2017.

Aloe vera leaf gel and juice are known to be rich in polysaccharides (complex sugars), especially acemannan and pectins. These large molecules are difficult to analyze with chromatographic techniques commonly used in analytical laboratories and therefore are often measured



using non-specific methods such as spectrophotometry or conductivity (which measures the total amount of ions). Some suppliers have taken advantage of these non-specific test methods by substituting or diluting the aloe polysaccharides with lower-cost carbohydrates, such as maltodextrin (a food additive usually derived from corn [*Zea mays*, Poaceae]) or sucrose (common table sugar).

Written by Ezra Bejar, PhD, an expert in botanical research in San Diego, California, the aloe vera bulletin lists the known adulterants, summarizes current analytical approaches to detect adulterants, and provides information on the nomenclature, supply chain, and market importance of aloe vera. It also discusses safety aspects of the known adulterants. The BAPB was reviewed by 27 experts from the nonprofit research sector, trade organizations, and herb industry.

Stefan Gafner, PhD, chief science officer of the American Botanical Council (ABC) and the technical director of BAPP, commented: "Aloe vera leaf juice is a very popular ingredient, with many applications. The use of reconstituted aloe vera juice from a 200x concentrated powder is of particular interest for companies in the personal care and cosmetic sector, since it provides a means to replace water as the most predominant ingredient by volume (which by law has to be listed as the first ingredient on the label), giving the product the appearance of a higher quality. Costs for 200x concentrated aloe leaf



Aloe Aloe vera
Photo ©2019 Steven Foster

powder are between \$225 and \$305 per kilogram, so there is a financial incentive for unethical suppliers to substitute aloe leaf powder with lower-cost carbohydrates.”

Mark Blumenthal, founder and executive director of ABC and the founder and director of BAPP, said: “Many experts in the herb industry have known for a long time that some aloe materials are adulterated. Because many aloe materials are in liquid or gel form, it is relatively easy for unethical aloe producers to ‘stretch’ the aloe material by adding low-cost liquids and various types of sugars to the ingredients to increase profits. By providing this bulletin to members of the herb, personal care, and cosmetic industries, BAPP hopes to reduce the amount of cheap, adulterated, and presumably ineffective aloe materials being used in consumer products.”

About the ABC-AHP-NCNPR Botanical Adulterants Prevention Program

The ABC-AHP (American Herbal Pharmacopoeia)-NCNPR (National Center for Natural Products Research at the University of Mississippi) Botanical Adulterants Prevention Program is an international consortium of nonprofit professional organizations, analytical laboratories, research centers, trade associations, industry members, and other parties with interest in herbs and medicinal plants. The program advises stakeholders and the public about the various challenges related to adulterated botanical ingredients sold in commerce. More than 200 US and international parties have financially supported or otherwise endorsed the program.

The program has released more than 50 extensively peer-reviewed publications, including *HerbalGram* articles,

BAPBs, Laboratory Guidance Documents, and Botanical Adulterants Monitor e-newsletters. All of the program’s publications are freely available on the program’s website, www.botanicaladulterants.org. HG



Botanical Adulterants Prevention Program
BOTANICAL ADULTERANTS PREVENTION BULLETIN
Adulteration of Aloe Vera (Aloe vera) Leaf Ingredients
 By Ezra Bejar, PhD
 American Botanical Council, Austin, TX 78723, USA
 Correspondence: emaj@abc-npnpr.org

Keywords: *Aloe vera*, aloe vera, adulteration, aloe vera gel, aloe vera filler, aloe vera leaf dry juice, aloe vera inner leaf juice, aloe vera whole leaf juice, aloe vera leaf, aloe vera mislabeled, aloe vera juice

Goal: The goal of this bulletin is to provide timely information and/or updates on issues of adulteration and mislabeling of aloe vera leaf juice ingredients that purport to meet the quality standard established by the International Aloe Science Council (IASC), an international trade association of aloe vera leaf juice ingredient producers and producer manufacturers based in the United States and founded in 1980, applicable for use in dietary supplement, personal care, and cosmetic products. The bulletin may serve as guidance for quality control personnel, the international herbal products industry, and the extended natural products community in general. It is also intended to present a summary of the scientific data and methods on the occurrence of species substitution and adulteration, the market situation, and economic and safety consequences for the consumer and the industry.

Definitions:
Aloe vera leaf: The aloe vera leaf in its entirety. It can be used as the raw material for the manufacture of aloe vera leaf juice ingredients.¹
Aloe vera whole leaf: The use of the term ‘whole’ was introduced to differentiate ingredients where the entire leaf is used as a starting raw material to create aloe vera leaf juice (without the latex component) from those that start with inner leaf as the raw material. However, the use of this term has led to confusion, since aloe vera whole leaf juice may be mistaken for a material containing latex.
Aloe vera inner leaf: The inner leaf (the clear, central parenchymatous tissues of the aloe leaf) that may be used as the raw material for aloe vera inner leaf juices.¹
Aloe vera leaf gel: In order to differentiate the inner leaf gel-like starting material from finished products that are gels by virtue of added gelling agents, the IASC defined aloe vera leaf gel as a liquid product with or without added thickening agents.^{1,2} The World Health Organization (WHO) defines aloe vera gel as the colorless mucilaginous gel obtained from the parenchymatous cells in the fresh leaves of *Aloe vera*.³ This is also correct, but is not generally found as an ingredient in finished products unless present as pulp.
Aloe vera inner leaf juice: According to the IASC, aloe vera inner leaf juice is manufactured by stripping off the outer leaf rind before further processing.² It may contain pulp or be pulp free. When thickening agents are added, it may be called a gel.¹ It may also have trace anthrones, which — depending on the manufacturing steps — may be removed through further processing. When dried, it is properly called aloe vera inner leaf dry juice, though common industry shorthand for this ingredient is 200x because 200 parts of liquid inner leaf juice yield approximately one part dry juice.
Aloe vera leaf juice: According to the IASC, aloe vera leaf

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Botanical Adulterants Prevention Program Receives NutraIngredients-USA's 2019 Editors Award for Industry Initiative of the Year

By ABC Staff

NutraIngredients-USA presented its 2019 Editors Award for Industry Initiative of the Year to the ABC-AHP-NCNPR Botanical Adulterants Prevention Program (BAPP), an international consortium dedicated to research and education to prevent industry use of adulterated and fraudulent botanical raw materials, botanical extracts, and essential oils.

The NutraIngredients-USA Awards are organized by NutraIngredients-USA.com, an online news source for the supplement, health, and nutrition industries, and are now in their second year. The Editors Award for Industry Initiative of the Year celebrates initiatives that improve quality, transparency, consumer confidence, and trust in the dietary supplement industry.¹

According to NutraIngredients-USA, “BAPP is an exemplary educational resource about adulteration in the botanical supply chain, with its growing body of peer-reviewed literature, laboratory guidance documents, bulletins, and newsletters.”

BAPP is a partnership among three leading nonprofit groups: the American Botanical Council (ABC), the American Herbal Pharmacopoeia (AHP), and the National Center for Natural Products Research (NCNPR) at the University of Mississippi. Initiated in 2010, with its first publications released in 2011, BAPP has focused on educating herb and natural product industry members and has accomplished this through the publication of more than 50 credible and authoritative peer-reviewed documents, as well as interviews with trade media, direct consultation with members of the industry, and speeches at industry, scientific, and professional conferences.

In addition to the three BAPP partners, more than 200 US and international parties have financially supported or otherwise endorsed the program, including nonprofit professional organizations, analytical laboratories, research centers, industry trade associations, industry members, and others. The program advises industry, researchers, health professionals, government agencies, the media, and the public about the various challenges related to adulterated botanical ingredients in commerce.

Stefan Gafner, PhD, chief science officer of ABC and technical director of BAPP, said: “This award belongs



to all the companies, organizations, analytical laboratories, and individuals who have contributed to BAPP by supporting it financially or by allocating time and resources to make it successful. It is their support that allows the initiative to succeed and ultimately helps prevent adulterated ingredients from being used in consumer products.”

BAPP Founder and Director Mark Blumenthal said: “We are deeply grateful to the editors of NutraIngredients-USA, Dr. Stephen Daniells and Hank Schultz, and the other staff members of NutraIngredients-USA for choosing BAPP to receive this award. NutraIngredients-USA has provided consistently reliable and fast-breaking coverage of our many peer-reviewed publications and projects and has really helped to forward the vitally needed educational mission of BAPP.”

The award was presented to ABC Development Director Denise Meikel at the NutraIngredients-USA Award Reception on June 3, 2019, in New Orleans, Louisiana, during the Institute of Food Technologists' 2019 Food Expo.

According to Meikel: “The NutraIngredients-USA award ceremony was lovely and well-attended by the many nominees and award winners. It was an honor to accept this meaningful award on behalf of the BAPP partners and the many worldwide supporters of this unique program.” HG

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Join more than 200 responsible companies, laboratories, nonprofits, trade associations, media outlets, and others
in the international herb and natural products/natural medicine community.

Become a valued underwriter of the ABC-AHP-NCNPR Botanical Adulterants Prevention Program, a multi-year, supply chain integrity program providing education about accidental and intentional adulteration of botanical materials and extracts on an international scale.

For more details on joining the program, and access to the free publications produced to date, please see www.botanicaladulterants.org or contact Denise Meikel at denise@herbalgram.org.



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American Herbal Pharmacopoeia Publishes Lycium (Goji) Berry Monograph and Therapeutic Compendium

By Connor Yearsley

On March 19, 2019, the American Herbal Pharmacopoeia (AHP) released a monograph containing quality control standards and a therapeutic compendium (as one document) for lycium (*Lycium barbarum*, *L. chinense*, Solanaceae) berry, also known as goji berry.¹ In ancient China, lycium was among the most preferred botanicals to promote health and longevity. Now, the fruit is a global “superfood,” and modern research is supporting its benefits. (Lycium was also the subject of an extensive herb profile in *HerbalGram* issue 113.²)

AHP monographs establish identification, purity, and quality standards for botanical raw materials and preparations. The therapeutic compendia provide a comprehensive review of pharmacological and safety data, including information on medical indications and supporting evidence from clinical, animal, and in vitro studies; modern and traditional uses; pharmacokinetics; pharmacodynamics; and guidance for structure and function claims. The compendia also cover dosages, interactions, side effects, contraindications, toxicology, and more. This information can be used by various individuals in the herbal community, from consumers and health practitioners to industry members like quality control personnel, purchasing agents, and dietary supplement manufacturers.

The lycium monograph and therapeutic compendium was a collaboration among AHP; Ruyi Yao, PhD, of the Institute of Medicinal Plant Development — Chinese Academy of Medical Sciences in Beijing; Thomas Avery Garran of the National Center for Chinese Materia Medica Resources and Daodi Herbs in Beijing; among others. In all, 13 authors from around the world contributed to the monograph and therapeutic compendium, and 32 experts from academia, industry, and medical practice reviewed it before publication. Work on the monograph began in 2016.

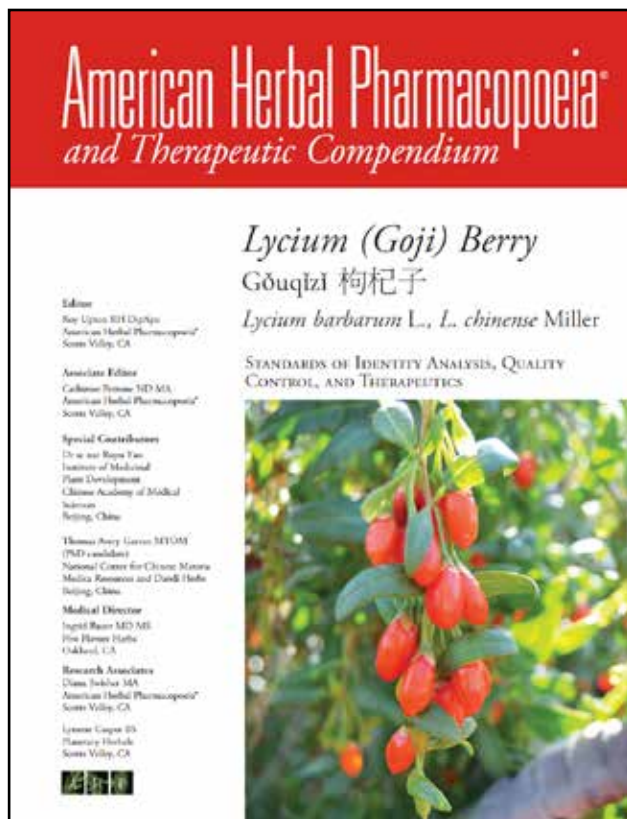
The genus *Lycium* belongs to the nightshade family and includes about 80 species, a number of which have historical and modern medicinal uses. Of these, the fruits of *L. barbarum* and *L. chinense* predominate in the international market. They have similar morphological, organoleptic, chemical, and pharmacological characteristics, and, along with several other *Lycium* species, have been used inter-

changeably in traditional Chinese medicine (TCM), traditional Japanese Kampo medicine, and traditional Korean medicine.

Both *L. barbarum* and *L. chinense* are deciduous shrubs native to China. Their oval red fruits (berries) are tangy but sweet, harvested when ripe and then dried or squeezed for juice. In TCM, the fruits feature prominently in tonic formulas, especially those intended to nourish the blood, liver, and kidneys, and to benefit the eyes. The root bark also is used in TCM practice. The plant is sometimes called “wolfberry,” which corresponds to the Chinese pinyin name *gou qi zi*, as the character for *gou* means “dog” or “wolf” and the character for *zi* means “small fruit.” This is also the source of the name “goji.”

Both preclinical and clinical research suggests lycium fruit may have anti-aging, antitumor, cytoprotective, immunomodulatory, and neuroprotective effects. It also may have benefits for fatigue/endurance, general wellbeing, glaucoma, glucose control in diabetes, and metabolism/energy expenditure. Recently, the juice of lycium fruit has become popular as an antioxidant-rich tonifier.

According to Roy Upton, RH (AHG), DipAyu, president of AHP and editor of the monograph, in the past few years, lycium fruit has transitioned from relative obscurity in the United States to being integrated into commercial cereals, bulk food products, candies, and juice products. “Its growth and popularity have been exponential, but many people are still unaware of the myriad of benefits associated with its consumption,” Upton wrote, adding that this made it logical to prioritize the creation of the monograph (email, April 18, 2019).



The AHP claims that this is the first comprehensive, English-language review of the traditional and scientific literature on lycium fruit, in conjunction with the establishment of testing standards for the fruit. The monograph is also significant, according to Upton, because it helps dispel some myths that one *Lycium* species is consistently superior to another. “Several species of *Lycium* have been used interchangeably, and, from a scientific perspective, no consistent points of superiority of one over another could be determined,” he wrote.

Yao, whose PhD thesis was used to develop the monograph, noted that the fruit has been used as both food and medicine for more than 2,000 years in Asia. It is also “a nutraceutical that developed from local to global,” Yao wrote (email, April 23, 2019). Although lycium’s identification, usage, and quality control are recorded in several pharmacopoeias, according to Yao, there is still room to educate more people, especially in the West, about different aspects of the plant. Yao thinks the AHP monograph is an important reference for both consumers and researchers, and he hopes “more people will enjoy healthy lives with goji.”

American Botanical Council (ABC) Founder and Executive Director Mark Blumenthal said: “The AHP goji berry monograph is a seminal, highly useful, and authoritative document that will be of immense value to members of the international medicinal plant community for many years to come. AHP has set a standard for the range and depth of information in its monographs that is not equaled by any other publication.”

The lycium monograph is the 39th monograph published by AHP since 1998. It is available for purchase through AHP’s website.¹ Bringing this monograph to the industry and the botanical community at large was made possible through the generous financial support of Herb Pharm, Mountain Rose Herbs, Nature’s Way, Ningxia Qixiang Biological Foodstuff, NOW Foods, Nuherbs, Planetary Herbals, Traditional Medicinals, Vitality Works, and WishGarden Herbs. HG

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Goji berry *Lycium chinense*
Photo ©2019 Steven Foster



Saw Palmetto Extract Reduces Markers of Prostatic Inflammation

Reviewed: Gravas S, Samarinas M, Zacharouli K, et al. The effect of hexanic extract of *Serenoa repens* on prostatic inflammation: results from a randomized biopsy study. *World J Urol*. March 2019;37(3):539-544. doi: 10.1007/s00345-018-2409-1.

By Shari Henson

Many men with lower urinary tract symptoms (LUTS) and benign prostatic hyperplasia (BPH) have chronic prostatic inflammation. Saw palmetto (*Serenoa repens*, Arecaceae) extract, which has demonstrated anti-inflammatory, antiandrogenic, and antiproliferative effects in vitro and in vivo, is one of the most commonly used plant extracts for the management of male LUTS, according to the authors of this study. Human clinical trials have investigated the effects of a hexanic extract of saw palmetto (HESr)* on male LUTS, but clinical studies investigating its effects on prostatic inflammation are scarce. The authors conducted a randomized, controlled study to evaluate the effects of HESr in patients diagnosed with prostatic inflammation. No standardization information about the HESr was provided.

The study was conducted at the University Hospital in Larissa, Greece. Of the 110 enrolled men with prostatic inflammation, which was confirmed by transrectal ultrasound-guided biopsy, 13 were excluded from the final analysis because they developed prostate cancer during the study. All patients had undergone biopsy because of an elevated prostate-specific antigen (PSA) level, a positive digital rectal examination (DRE), or both. The patients were randomly assigned to receive 320 mg of HESr daily for six months (n = 49) or no therapy (control group, n = 48). The patients underwent a second biopsy at the end of the study.

The primary endpoint was the change in inflammation from baseline to study end, which was assessed by total Irani's score (a prostatic inflammation scoring system) and immunohistochemical staining. The extent of inflammation was graded from 0 to 3 based on the degree of invasion of inflam-

matory cells in prostatic tissue. The aggressiveness of inflammation was graded from 0 to 3 based on the degree of contact or disruption of prostatic glandular epithelium by inflammatory cells.

Secondary endpoints were changes in prostatic inflammation assessed by immunohistochemical staining for the following antibodies specific for inflammatory cells: CD3, CD4,



Saw palmetto *Serenoa repens*
Photo ©2019 Steven Foster

Study Details: At a Glance

Study Design	Randomized, controlled biopsy study
Participants	97 men with prostatic inflammation
Study Length	Six months
Intervention	Permixon® (Pierre Fabre; Boulogne-Billancourt, France)
Control	No treatment
Disclosures	One author (Gravas) received speaker honoraria from Astellas Pharma and Pierre Fabre Medicament and consultancy honoraria from Astellas Pharma and GlaxoSmithKline.

* The brand of the saw palmetto extract used in the study is not named in the original article, but ABC confirmed with one of the authors that the HESr is Permixon® (Pierre Fabre; Boulogne-Billancourt, France), which is sold as Libeprosta® in Greece.

CD8, CD20, and CD163. The expression of each antibody in prostate tissue was graded from 0 to 3.

At baseline, the mean inflammation grading score for the HESr group was 1.55; this score significantly decreased to 0.79 after the six-month treatment period ($P = 0.001$). The mean aggressiveness grading score decreased from 1.55 to 0.87 during the study ($P = 0.001$). In the control group, the mean inflammation grading score decreased from 1.44 to 1.23 ($P = 0.09$), and the mean aggressiveness grading score decreased from 1.09 to 0.89 ($P = 0.74$) from baseline to the end of the study.

The total Irani's score mean decreased significantly in the HESr group ($P = 0.001$) and slightly but not significantly in the control group ($P = 0.52$) during the study.

A significantly greater decrease in inflammation grading scores ($P = 0.001$), aggressiveness grading scores ($P = 0.009$), and total Irani's score ($P = 0.001$) was found in the HESr group compared with the control group. The inflammation score was increased in 25% of patients (12 out of 48) in the control group while only 6.1% (3 out of 49) of the HESr patients had a higher Irani's score at the second biopsy.

Immunohistochemical staining revealed a significant decrease in the production of CD3, CD4, and CD8 (marker proteins for T-leukocytes), CD20 (for B-leukocytes), and CD163 (for macrophages) antibodies in the HESr group at the second biopsy compared with the baseline biopsy results ($P < 0.001$ for all). No significant changes were reported in the control group. The changes in reduction of cells involved in the inflammatory response were significantly greater in the HESr group after six months compared with the control group ($P < 0.001$ for CD3, CD8, CD20, and CD163; and $P = 0.002$ for CD4).

According to the authors, "These results suggest that inflammation seems to progress over time and confirm the anti-inflammatory properties of HESr." The results are limited by the fact that only patients with elevated serum PSA levels or a positive DRE, or both, were eligible for a prostate biopsy, and only those with confirmed inflammation on baseline biopsy were included in the study. The study was also limited by the lack of a placebo control. The authors suggest that a larger trial should investigate if and how the improvements in prostatic inflammation reported here can be translated into clinical practice and if patients with greater decreases in prostatic inflammation experience LUTS relief.

The authors concluded that "HESr seems to reduce prostatic inflammation in terms of histological and immunohistochemical parameters in patients who underwent two biopsies due to elevated PSA and/or suspicious DRE." HG



Cognitive and Cerebral Blood Flow Effects of Greek Mountain Tea

Reviewed: Wightman EL, Jackson PA, Khan J, et al. The acute and chronic cognitive and cerebral blood flow effects of a *Sideritis scardica* (Greek mountain tea) extract: a double blind, randomized, placebo controlled, parallel groups study in healthy humans. *Nutrients*. July 24, 2018;10(8). doi: 10.3390/nu10080955.

By Sandra Jean, MS

The aerial parts of Greek mountain tea (GMT; *Sideritis scardica*, Lamiaceae) have been used traditionally to treat respiratory and digestive conditions. These uses are supported by in vitro studies that have demonstrated antioxidant, anti-inflammatory, and gastroprotective effects. GMT contains polyphenols (e.g., ferulic acid, chlorogenic acid, and apigenin) that are reported to affect blood flow, neurotransmitter reuptake, and cognition in animal and human studies. Several clinical trials have reported improvements in cognition and mood when GMT was tested in combination with B vitamins or an extract of bacopa (*Bacopa monnieri*, Plantaginaceae) aerial parts. However, no clinical trials have investigated the cognitive effects of GMT alone. The purpose of this randomized, double-blind, placebo-controlled trial was to assess the acute and chronic effects of two doses of GMT on cognition, mood, and cerebral blood flow in older adults.

Healthy adults (N = 155, aged 50-70 years) were enrolled at Northumbria University in Newcastle upon Tyne, UK, from February to August 2017. Included participants were non-smokers and had a body mass index of 18-35 kg/m². Excluded participants were pregnant or breastfeeding, had a history of substance abuse or psychiatric illness, were taking medications other than contraceptives or hormone replacements, were taking dietary supplements that would interfere with the study, had a serious chronic condition, or had a current diagnosis of anxiety, depression, or a sleep disorder.

Participants were randomly assigned to one of four groups: low-dose GMT extract (475 mg), high-dose GMT extract (950 mg), active control (240 mg ginkgo [*Ginkgo biloba*, Ginkgoaceae] leaf extract; no additional details provided), or placebo. Participants took one capsule at breakfast and one capsule at dinner every day for 28 days. The GMT extract was a 20% ethanol extract with a total phenolic content of 6.25%. No additional information was provided about the source or processing of the GMT or ginkgo extract.

On day one and day 28 of the trial, participants completed a battery of cognitive tests, filled out the State-Trait Anxiety Inventory (STAI) questionnaire, and had blood pressure and heart rate measured before and after taking the capsules. A subset of participants (n = 57) underwent near infrared spectroscopy (NIRS) testing at various time points to measure markers of cerebral blood flow in the prefrontal cortex (total hemoglobin, oxygenated hemoglobin, deoxygenated hemoglobin, and oxygen saturation) before and after taking the capsules.

The authors did not report if there were any significant clinical or demographic differences among the four groups at baseline. Three participants withdrew from the trial due to personal reasons, and one participant in the placebo group withdrew due to illness. The authors discussed only statistically significant results because of the large number of analyses performed.

Mean performance on the picture recognition task was significantly better in the high-dose GMT group compared to the ginkgo group on day one ($P = 0.026$) and on day 28 ($P = 0.005$).

Study Details: At a Glance

Study Details: At a Glance	
Study Design	Randomized, double-blind, placebo-controlled trial
Participants	140 healthy adults
Study Length	28 days
Intervention	475 mg Greek mountain tea (GMT) extract, 950 mg GMT extract, or 240 mg ginkgo leaf extract
Control	Placebo
Disclosures	The study was funded by Finzelberg GmbH & Co. KG., Martin Bauer Group. Three authors (Heiner, Feistel, and Suarez) are employees of Finzelberg GmbH & Co. KG. The other authors declared no conflicts of interest.

The number of false alarms (i.e., mistakes) on the Rapid Visual Information Processing test was significantly lower in the high-dose GMT group compared to the placebo group on day 28 ($P = 0.017$). STAI test scores were significantly decreased (improved) from day one to day 28 in the high-dose GMT group compared to the placebo group ($P = 0.022$) and the ginkgo group ($P = 0.028$). At several time points on day one, both GMT groups had significantly greater oxygen saturation while performing cognitively demanding tasks than the placebo group ($P < 0.05$ for all).

On day one, the high-dose GMT group had significantly greater total hemoglobin levels at all time points compared to the placebo group ($P < 0.05$ for all). The low-dose GMT group had significantly greater total hemoglobin levels at some time points compared to the placebo group ($P < 0.05$). Both GMT groups had significantly higher oxygenated hemoglobin levels at most time points on day one compared to the placebo group ($P < 0.05$ for all). The ginkgo group had significantly lower total hemoglobin levels at all time points and lower oxygenated hemoglobin levels at most time points on day 28 compared to the placebo group ($P < 0.05$ for all).

The main finding of this trial, according to the authors, was that 950 mg GMT extract significantly reduced anxiety after 28 days. The high dose of GMT improved performance on two cognitive tasks at the beginning and end of the intervention, suggesting an acute effect of high-dose GMT. The cognitive effects of GMT observed on the first day coincide with increased cerebral blood flow. This modulation of cerebral blood flow is consistent with effects of other plant polyphenols and may be due to nitric oxide-induced vasodilation.

The authors note that the reduced cerebral blood flow and lack of cognitive effects observed for the ginkgo group are not consistent with the literature. The short duration of the intervention or composition of the ginkgo material may be responsible for the lack of effect. The authors explain the sample size was too small to allow for subgroup analyses based on gender. Future trials should examine gender differences in response to GMT and further explore the optimal dose, as the lower dose of GMT also showed some benefits. The authors did not discuss adverse events related to any interventions, and it is not clear if safety data were collected. HG

Aloe Vera Inner Leaf Gel and Peppermint Essential Oil Preparation Improves Oral Health of Patients in Hospital Intensive Care Units

Reviewed: Yazdannik A, Mahjobipour H, Ghafari S, Bekhradi R, Yousefi H. The effects of *Aloe vera*-peppermint (Veramin) moisturizing gel on mouth dryness and oral health among patients hospitalized in intensive care units: a triple-blind randomized placebo-controlled trial. *J Res Pharm Pract.* April-June 2018;7(2):104-110. doi: 10.4103/rpp.JRPP_18_21.

By Shari Henson

Dry mouth is common among patients in hospital intensive care units (ICUs). It can be caused by endotracheal or orogastric tubes and can be worsened by restricted fluid intake associated with certain respiratory, cardiac, and renal conditions. Dry mouth can lead to oral mucositis and gingivitis, cavities and plaque, and bacterial growth in the mouth and throat. It also can predispose patients to developing pneumonia.

Aloe vera (*Aloe vera*, Asphodelaceae) inner leaf gel contains ingredients that can improve skin and mucosa hydration and help heal wounds. Peppermint (*Mentha × piperita*, Lamiaceae) leaf essential oil has antibacterial, cooling, and pain-relieving effects. The authors conducted a randomized, triple-blind, placebo-controlled clinical trial to analyze the effects of the moisturizing gel Veramin® (Barij Essence Pharmaceutical Company; Kashan, Iran), which contains aloe vera inner leaf gel and peppermint essential oil, on mouth dryness and oral health in patients in ICUs.

Patients eligible for the study were hospitalized from November 2016 to August 2017 in the ICU of a teaching

Study Details: At a Glance	
Study Design	Randomized, triple-blind, placebo-controlled trial
Participants	76 intubated patients in a hospital ICU
Study Length	Five days
Intervention	Veramin® gel (Barij Essence Pharmaceutical Company; Kashan, Iran)
Control	Placebo gel
Disclosures	One author (Bekhradi) is employed by Barij Essence Pharmaceutical Company.

hospital in Isfahan, Iran. They were 18 to 65 years of age, had an endotracheal tube in place through the mouth, had been in the ICU for less than 24 hours, and had not been in another hospital ward before being admitted to the ICU. They did not have a history of autoimmune disorders, pneumonia, or sepsis; were not sensitive to herbs; did not wear dentures; and had no lesions in or around the mouth.

Eighty patients were randomly and equally assigned to be treated with either Veramin or placebo. Veramin gel contains aloe vera inner leaf gel, peppermint essential oil, carboxymethyl cellulose, propylene glycol, and potassium sorbate. The placebo gel was carboxymethyl cellulose-based, and contained propylene glycol, potassium sorbate, and water. A 0.12% chlorhexidine solution was used to brush the inner and outer surfaces of the teeth and tongue every 12 hours. The Veramin and placebo gels were applied every four hours to the oral mucosa, gums, and tongue after brushing.

The primary outcome was reduction of mouth dryness, which was assessed by a dentist at baseline and on days



three and five of the study by using the visual Challacombe Scale, which scores dryness from 1 to 10, with higher scores representing more severe dryness. The secondary outcome was oral health as measured by using the Mucosal-Plaque Score, with higher scores indicating poor oral health.

No baseline between-group differences were seen in age, gender, chronic health conditions, antacid consumption, cigarette smoking, or feeding route. During the study, one patient died and one patient was weaned from the ventilator in the Veramin group. In the placebo group, two patients died during the study. Thirty-eight patients in each group were included in the final analysis, and no adverse effects were reported during the study.

Results of the Mann-Whitney U test, a statistical measure for population differences, revealed that at baseline, mouth dryness scores were significantly higher in the Veramin group compared with the placebo group ($P = 0.0001$). At day three, the between-group difference was not significant ($P = 0.551$); however, at day five, mouth dryness was significantly less in the Veramin group compared with the placebo group ($P = 0.0001$). Within-group analyses indicated a significant decrease in the mean score of mouth dryness in the Veramin group ($P = 0.0001$) and no significant change in the placebo group by day five.

The Mann-Whitney U test revealed a significantly higher oral health score in the Veramin group at baseline compared with the placebo group ($P = 0.026$); however, the score in the Veramin group was significantly lower than in the placebo group on day three ($P = 0.003$) and on day five ($P = 0.0001$). The mean score for oral health significantly decreased from baseline to day five in the Veramin group ($P = 0.0001$); the change in the oral health score in the placebo group was not significant.

Limitations of this study include the short follow-up period, the relatively small sample size, a limited definition of oral health, and the use of a single location.

The authors concluded that “Veramin moisturizing gel is effective in significantly relieving mouth dryness, preventing dental plaque formation, and improving oral health” and “can be used for improving oral care outcomes in ICUs.” HG



Peppermint *Mentha x piperita*
Photo ©2019 Steven Foster

Meta-analysis: Elderberry Reduces Upper Respiratory Symptoms

Reviewed: Hawkins J, Baker C, Cherry L, Dunne E. Black elderberry (*Sambucus nigra*) supplementation effectively treats upper respiratory symptoms: A meta-analysis of randomized, controlled clinical trials. *Complement Ther Med*. February 2019;42:361-365. doi: 10.1016/j.ctim.2018.12.004.

By Sandra Jean, MS

The common cold and influenza (flu) viruses often cause upper respiratory symptoms such as runny nose, nasal congestion, sore throat, and cough. Over-the-counter medications can help reduce symptoms, and prescription pharmaceuticals may be used in documented cases of flu, but there are concerns about the safety and effectiveness of these drugs for treating viral infections, especially when used in children. Antibiotics may also be prescribed, even though antibiotics are considered ineffective for viral infections, and misuse of antibiotics contributes to antibiotic-resistant pathogens. Elderberry (*Sambucus nigra*, Adoxaceae) fruit has been used traditionally to treat the common cold and flu. Elderberries contain anthocyanins that have antiviral and immune-stimulating effects. This meta-analysis was conducted to quantify the statistical strength of the relationship (i.e., the effect size) between elderberry supplementation and reduction of upper respiratory symptoms caused by cold and flu infections.

PubMed, Google Scholar, and ScienceDirect databases were searched from inception to September 2018. Search terms included “elderberry,” “sambucus,” “influenza,” “flu,” “respiratory,” “cough,” and “cold.” No limitations were applied to the search. Studies were included if they were randomized, placebo-controlled clinical trials that used elderberry supplementation as the intervention and assessed upper respiratory symptoms as the primary outcome. Trials were excluded if elderberry was combined with another substance or if the primary outcome measures were cytokine production or anti-inflammatory activity.

A total of 137 citations were identified. After screening, four trials met the eligibility criteria and were included in the meta-analysis. The trials were published from 1995 to 2016 and included a total of 180 patients, with 89 in the elderberry groups and 91 in the placebo groups.

In all four studies, upper respiratory symptoms were self-reported. The trials tested “commercially prepared products,” but no additional information was provided about the elderberry products or doses used. Two trials identified laboratory-confirmed flu as the cause of symptoms in patients. One trial evaluated symptoms that were consistent with a diagnosis of flu, and another trial evaluated

Study Details: At a Glance	
Study Design	Meta-analysis
Included Studies	Four randomized, controlled trials (N = 180 total)
Length of Studies	Not stated
Intervention	Various elderberry supplements
Control	Placebo (no additional details provided)
Disclosures	None declared

symptoms that were consistent with the common cold. Two trials excluded patients who had received the flu vaccine, and two trials only excluded patients who had received the vaccine just before the start of the trial. Moderator analysis (i.e., determination if a third variable affects the relation between two other variables) was conducted to determine if the cause of the symptoms (cold versus flu) and flu

vaccine status influenced the results.

Elderberry supplementation was associated with a significantly reduced duration of upper respiratory symptoms compared to placebo. The weighted effect size was large ($P < 0.001$), and heterogeneity was high among the four trials. Moderator analysis found that elderberry supplementation correlated with reduced symptoms caused by both cold flu infections. Elderberry was more effective for reducing symptoms caused by flu ($P < 0.001$) than for symptoms caused by the common cold ($P = 0.087$). Moderator analysis found that flu vaccination status did not influence the effects of elderberry supplementation. No publication bias was found, and the risk of bias within studies was rated as low using the Downs and Black checklist.

This meta-analysis provides evidence that elderberry supplementation can reduce the duration and severity of upper respiratory symptoms in people with colds and flu. Elderberry supplementation had a greater effect on symptoms caused by flu than on symptoms caused by colds. The authors point out that this finding should be interpreted with caution because only one of the four trials enrolled people with colds.

According to the authors, future trials should enroll more patients with cold virus infections and involve larger sample sizes. The authors concluded: “These findings present [elderberry preparations as] an alternative to antibiotic misuse for upper respiratory symptoms due to viral infections and a potentially safer alternative to prescription drugs for routine cases of the common cold and influenza.” HG

Garlic Extract Reduces Markers of Inflammation in Patients on Peritoneal Dialysis

Reviewed: Zare E, Alirezaei A, Bakhtiyari M, Mansouri A. Evaluating the effect of garlic extract on serum inflammatory markers of peritoneal dialysis patients: a randomized double-blind clinical trial study. *BMC Nephrol.* January 25, 2019;20(1):26. doi: 10.1186/s12882-019-1204-6.

By Shari Henson

Patients with end-stage renal disease who depend on maintenance dialysis are at a high risk of cardiovascular disease (CVD). In those patients, inflammation is a critical risk factor for the development of CVD. Garlic (*Allium sativum*, Amaryllidaceae) has been used to treat various disorders because of its many therapeutic properties, including anti-inflammatory actions. The authors conducted a parallel, randomized, double-blind, placebo-controlled clinical trial to investigate the effects of garlic on markers of inflammation and organ function in patients undergoing peritoneal dialysis.

Forty-two patients at Shafa Dialysis Center in Tehran, Iran were selected for the study. Twenty-one of those patients (aged 52.8 ± 18.2 years) were randomly assigned to a control group that received standard treatment (i.e., dialysis) and took a placebo tablet (not described) twice daily for eight weeks. The other 21 patients (aged 56.0 ± 16.0 years) also received standard treatment and took 400 mg of standardized garlic extract twice daily for eight weeks. Each garlic extract tablet contained 1 mg of alliin, a primary bioactive component of garlic. All study tablets were produced by Amin Chemical and Pharmaceutical Company in Tehran. Two patients in the garlic group transferred to other hospitals and were lost to follow-up.

Study Details: At a Glance	
Study Design	Parallel, randomized, double-blind, placebo-controlled trial
Participants	40 patients on dialysis
Study Length	Eight weeks
Intervention	400 mg standardized garlic extract (Amin Chemical and Pharmaceutical Company; Tehran, Iran)
Control	Placebo
Disclosures	None declared



Garlic *Allium sativum*
Photo ©2019 Steven Foster

The primary outcomes of this study were changes in erythrocyte sedimentation rate (ESR) and serum concentrations of the inflammatory markers interleukin 6 (IL-6) and C-reactive protein (CRP). Secondary outcomes were changes in total cholesterol and triglyceride levels, liver and renal function markers, peritoneal function tests (to measure the adequacy of peritoneal dialysis), and other biomarkers (homocysteine, sodium, potassium, phosphorus, calcium, ferritin, uric acid, and parathyroid hormone).

Fasting blood samples were collected at baseline and after eight weeks. At baseline, most of the biochemical measurements were similar between the two groups. The exceptions were lower levels of CRP ($P = 0.014$) and total cholesterol ($P = 0.024$) and higher levels of uric acid ($P = 0.017$) in the control group compared with the garlic group.

After eight weeks of treatment, the mean ESR was significantly lower ($P = 0.027$) and potassium levels were significantly higher ($P = 0.039$) in the garlic group compared with the placebo group. The increase in potassium levels in the garlic group is similar to findings of an earlier study that demonstrated garlic can help maintain electrolyte balance (e.g., potassium and sodium levels) and improve renal function.¹

Significant reductions were seen in IL-6 ($P < 0.001$), CRP ($P < 0.001$), ESR ($P = 0.021$), and homocysteine levels ($P < 0.001$) in the garlic group compared to baseline. However, when adjusted for baseline differences, the changes in IL-6 and homocysteine over time were not significantly different between groups. Reductions from baseline in CRP ($P = 0.547$) and ESR ($P = 0.797$) in the control group were not significant.

The authors concluded the standardized garlic extract taken for eight weeks significantly reduced inflammatory markers. Because increases in such markers can be life-threatening for patients on peritoneal dialysis, the authors suggest “that this safe and well-tolerated natural substance [can] be prescribed in an attempt to attenuate the inflammatory response in these patients.” In support of their findings, the authors cite a previous meta-analysis that found garlic intake reduces inflammatory markers and improves cardiovascular health by lowering pro-inflammatory cytokines.²

Because of their study’s small sample size, the authors used nonparametric tests with lower power to detect potential differences between the two groups. Trials using larger patient populations should be conducted to further explore the potential anti-inflammatory benefits of garlic in patients undergoing peritoneal dialysis. HG

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Garlic *Allium sativum*
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Key Takeaways from the FDA's Public Hearing on Products Containing Cannabis and Cannabis-Derived Compounds

Safety, quality, and marketing claims are the main concerns of the agency

By Stefan Gafner, PhD

Cannabis (*Cannabis sativa*, Cannabaceae) and cannabis-derived ingredients have seen a huge increase in popularity. Those who attended the Natural Products Expo West trade show in March 2019 were able to witness the booming cannabis industry, with hemp extracts and cannabidiol (CBD) as highlighted ingredients in many food, beverage, cosmetic, and dietary supplement products. According to the US Food and Drug Administration (FDA), only three hemp-derived ingredients can legally be sold in food in the United States: hulled hemp seed, hemp seed protein, and hemp seed oil. (Hemp is defined as a cannabis plant, and any part or derivative thereof, with a delta-9 tetrahydrocannabinol [THC] concentration of no more than 0.3%. Hemp seeds reportedly contain no naturally occurring THC or CBD.) However, this has not hindered the manufacture and distribution of products containing hemp extracts with various amounts of CBD, or even synthetic CBD.

According to some estimates, 22 million people in the United States consume hemp-containing products, and the growing industry has created more than 200,000 jobs and recorded \$2 billion in sales in 2018.^{1,2} In order to obtain more information about the safety, manufacturing, product quality, marketing, labeling, and sales of products that contain cannabis or cannabis-derived ingredients, the FDA organized a public hearing on May 31, 2019, in Silver Spring, Maryland.

Seats for the hearing were taken quickly, and a web feed was available for those who could not participate on site. A total of 107 people were scheduled to speak, and there were a few last-minute additions to the program. Commentators and presenters represented industry, academia, regulators, trade organizations, law firms, health professionals, and consumers. Below are some key takeaways.

1. Industry representatives want clear regulations that allow CBD to be marketed as a dietary ingredient.

One of the common threads throughout the hearing was that the current regulatory situation for cannabis-derived ingredients is not satisfactory and that the FDA should move forward quickly with new regulations or enforce the current regulations more vigorously. Despite the fact that CBD is the main ingredient in an FDA-approved medicine (Epidiolex®; GW Pharmaceuticals; Cambridge, UK), which effectively prevents CBD's use as a dietary ingredient according to section 201(ff) of the Federal Food, Drug, and Cosmetic Act (FDCA),³ representatives of the dietary supplement trade proposed that CBD should be permissible as a dietary ingredient after submission of a new dietary ingredient notification (NDIN), in which the safety of the new dietary ingredient is documented for its intended use. David Spangler, the senior vice president in charge of policy and general counsel for the Consumer Healthcare Products Association expressed support for the current drug development process with isolated cannabinoids but suggested that CBD should be exempt from the new drug approval (NDA) process and allowed as a dietary ingredient for those companies that have successfully submitted a NDIN.

In a written statement, United Natural Products Alliance President Loren Israelsen wrote: "I urge you [the FDA] to rely on the framework of DSHEA [the Dietary Supplement Health and Education Act of 1994], which we believe is the appropriate approach to regulate CBD and hemp extract products as dietary supplements. Once the major challenges are resolved with the Section 201ff exclusionary rule³ and an appropriate safe total daily consumption level for CBD is worked out, all other consumer safeguards in DSHEA and ensuing amendments should apply, including ... NDINs, adherence to current Good Manufacturing Practices (cGMPs), product labeling, serious adverse event reporting, and structure/function claims."



Cannabis *Cannabis sativa*
Photo ©2019 Steven Foster

American Herbal Products Association President Michael McGuffin commented that regulations should allow the use of hemp extracts with natural levels of CBD in dietary supplements. While current regulations (i.e., Section 201(ff) of the FDCA) exclude the use of CBD as a dietary ingredient, McGuffin suggested that other forms of CBD should also be permitted for use in dietary supplements, possibly as part of an interim final rule. Megan Olsen, assistant general counsel for the Council for Responsible Nutrition (CRN) emphasized the need for quick rulemaking and commented that safety concerns should not preclude initiation of new regulations by the FDA.

Steve Mister, president and CEO of CRN, also favored regulation that could allow the sale of CBD-containing supplements for those companies that have filed an NDIN, explaining that using this approach would provide an incentive to companies with an interest in CBD to invest more money into safety research. These comments were echoed by Aaron Secrist, vice president of quality and regulatory affairs at NOW Health Group, who added that the lack of enforcement of the current regulations puts those companies that follow the law at a competitive disadvantage and gives a three- to five-year head start to those companies that illegally sell products containing cannabis-derived ingredients.

2. Quality and labeling of cannabis-derived ingredients need to improve.

A number of speakers emphasized the need for better quality and accuracy of labeling. Anne Hassel, representing the Holyoke Visiting Nurse Association, shared

her concerns about the absence of quality standards for cannabis-derived products and the number of products on the market that improperly declare their contents or are contaminated with pesticides or potentially harmful microbes. She pointed to a study in the *Journal of the American Medical Association*, in which researchers analyzed 84 CBD products available online and found that 36 (42.9%) of the products contained less than 90% of the declared amount of CBD, while 22 (26.2%) contained 110% or more of the labeled quantity. The remaining 26 products were within 10% of the labeled content. According to the study, CBD oils were the product category with the most accurately labeled products, while vaporization (“vape”) liquid products were the most frequently mislabeled. THC, the primary psychoactive/intoxicating compound in cannabis, at a level of up to 6.43 mg/mL, was present in 18 (21.4%) of the 84 samples tested.⁴

Bill Gurley, PhD, a professor in the department of pharmaceutical sciences at the University of Arkansas for Medical Sciences in Little Rock, presented the results of an analysis of 25 CBD products sold in retail markets in Mississippi. CBD contents ranged from none to 1,140 mg per container, with only two products (8%) having between 90-110% of the labeled amount. Four products (16%) contained undeclared synthetic cannabinoids, and three products (12%) contained THC above the allowed 0.3%. Concerns about adulteration with synthetic cannabinoids also were voiced by Michelle Peace, PhD, an assistant professor of forensic science at the Virginia Commonwealth University in Richmond, who provided results from a number of her own investigations into the authenticity of CBD products.⁵ Her presentation included descriptions of adverse side effects from a number of people after consuming the adulterated products.

3. Questions remain about safety.

While many representatives from the cannabis industry and some health care professionals underscored the history of safe use of cannabis-derived ingredients, other medical professionals, researchers, and drug manufacturers pointed to gaps in current knowledge regarding the long-term impact of consumption of cannabis and cannabis-derived compounds.

The FDA was particularly interested in safety data in various populations (e.g., children and pregnant women), and how the mode of administration may impact the effects of the ingredients. Alice Mead, vice president of US public policy and public affairs at Greenwich Biosciences, the US subsidiary of GW Pharmaceuticals, noted that much about CBD remains unknown. She also explained that an increased risk of liver injury was observed in patients using Epidiolex, and a number of clinically relevant drug interactions, notably with the anti-coagulant drug warfarin, were documented during clinical trials with Epidiolex. While the risks of adverse events when taking CBD at lower dosages generally are considered low, many of the speakers, when asked by the FDA representatives, struggled to provide exact dosages at which CBD can be taken safely.



4. Many consumers rely on CBD products.

A national survey on CBD use of 4,355 adults in the United States provided some insights into the reasons for the popularity of CBD-containing products. Results of the survey were presented by Lisa Gill, deputy editor of *Consumer Reports*. According to the survey, 26% of the respondents had tried CBD at least once in the past two years, with 37% of those individuals using it to reduce stress or anxiety, or to help relax. Other reasons for use were to relieve joint pain (24%), for recreational activity (11%), or to improve sleep (10%). Importantly, 63% of the CBD users found it to be extremely or very effective for reducing stress or anxiety, or for helping to relax. Fifty-two percent of the CBD users found it extremely or very effective for better sleep, and 38% of the CBD users considered it to be highly efficacious for joint pain. Side effects, most commonly changes in appetite and fatigue, were reported by 26% of the CBD users. Edibles are the consumer-preferred way to use CBD, followed by liquids or sprays, vaping devices, and topical products, according to the survey.

A number of individuals provided emotional personal testimonies such as a narrative from Sally Schindel, of the Marijuana Victims Alliance, about losing her son to what she described as “marijuana-induced suicide,” and the story of James Werline’s daughter Camila, who, after having countless seizures daily during the first months of her life, has been seizure-free for six months thanks to Epidiolex. According to Jacqueline French, MD, professor at the New York University Department of Neurology and Comprehensive Epilepsy Center, many consumers cannot afford the costs of Epidiolex since they may suffer from a type of epilepsy for which the drug has not been approved by the FDA. Such off-label use is usually not covered by health insurance, prompting many patients to seek out other CBD products.

Conclusion

The explosion of cannabis-derived ingredients sold in food, beverage, cosmetic, and dietary supplement products has created a billion-dollar industry despite legal challenges. A notable case is CBD, which is very popular as a food and beverage ingredient, but at the same time is used by patients suffering from debilitating diseases because of its reported and demonstrated effects. While CBD is promising for a number of diseases and conditions, quality of available CBD products is a problem and questions remain about overall safety. The current regulatory framework has resulted in confusion for manufacturers and consumers alike. Regulations that provide incentives and remove barriers to carry out research are needed, as is enforcement of current or future regulations regarding the sale of products containing cannabis or cannabis-derived compounds. HG

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A Preliminary Sustainability Report of Ayahuasca Vine in the Peruvian Amazon

By Chris Kilham

Issue 120 of *HerbalGram* contained the feature article “Ayahuasca Vine Harvesting in the Peruvian Amazon” that detailed work conducted by my Peruvian research team and me to assess the supply of ayahuasca vine (*Banisteriopsis caapi*, Malpighiaceae) in Peru’s Loreto and Ucayali departments, where ayahuasca activity is heavily concentrated. The report described findings from two study trips conducted in January and June 2018.

After that article was published, our team conducted two more research expeditions to collect new information. The first of those was in December 2018 in the Pucallpa area in the Ucayali department of Peru, and the second was in April 2019 in Junin Pablo and the area near Lago Imiria. On both trips, my team members included long-time traveling partner Sergio Cam of Chakarunas Trading Company, boat captain Jaime Baca, and Shipibo agroforestry engineering student Kleylie Vargas.

Ayahuasca, a psychedelic brew made from ayahuasca vine and other psychoactive plants, usually the leaves of *chakruna* (*Psychotria viridis*, Rubiaceae) or *huambisa* (*Diplopterys cabrerana*, Malpighiaceae), is now highly popular in Peru and other areas of the Amazon. It also is brewed and exported for increasingly popular ceremonial use in the United States and elsewhere. Ayahuasca has been employed for healing and divination in the Amazon rainforest by various native groups for centuries.

Popular media, music, and film celebrities and two Brazil-based ayahuasca churches, Santo Daime and União do Vegetal, have significantly boosted interest in the brew beyond its native range. Over the past few years, many people have expressed concern that the vine, which needs at least five years to reach maturity, may be imperiled due to overharvesting. Our intention was to investigate ayahuasca

forest harvesting and cultivation in Peru’s Loreto and Ucayali departments to assess the population status of the vine.

One piece of the chain of ayahuasca trade we had not seen was the arrival of forest-harvested vine to the port of Pucallpa, the main trading center for vine going to both the Pucallpa and Iquitos areas. Vine that comes into Pucallpa is purchased by local *ayahuasceros* (ayahuasca shamans) and ayahuasca brewers, and a great deal of the vine is forwarded on to ayahuasca centers in the Iquitos area. We contacted



Chris Kilham, Antonio Cauper, and a large ayahuasca vine.
Photo ©2019 Chris Kilham.

Antonio Cauper, a harvester from Junin Pablo on the Rio Tamaya with whom we had spent time on our second research trip. Antonio informed us that he would be heading into Pucallpa with a load of vine, so we arranged to meet him.

Late morning on a Thursday, Antonio arrived into port on a *rapido*. So named because they are fast boats, rapidos ply the Ucayali River, acting as buses and taxis, delivering people and goods from one area to another. Rapidos are economical and are used by most people living on or near the rivers to get around. Antonio previously had told us that when he brings a boatload of vine to Pucallpa, he is spotted easily by buyers who work the waterfront. The Pucallpa waterfront is a chaos of boats, both small and large, many hauling cargo, and large vessels carrying hundreds of passengers at a time north to Iquitos along the Ucayali River. Vendors sell food along the shore, and laborers carry goods to and from boats.

Antonio arrived with eight 30-kg (66-lb) bundles of vine. The rapido had no special cargo space, so the vine was packed between seats. The cost of transport per bundle from Junin Pablo to Pucallpa was 5 soles, or \$1.50.

Once Antonio's rapido arrived, a couple dozen passengers disembarked, and porters went on board to unload cargo. One man hauled out the eight bundles of vine, one bundle at a time, for 1 sol each, or \$0.30.

Antonio already had arranged to supply this particular load of vine to a specific customer. So, instead of waiting for buyers to spot him, he had the ayahuasca loaded onto

a *moto*, or moto-taxi. The moto is the most popular and economical conveyance in Amazon cities, and these vehicles are used to carry people and goods of all sorts.

A Second Conversation with Francis Chauca

After the arrival of Antonio's load of vine, we headed across Pucallpa to see Francis Chauca, who I mistakenly referred to as Carlos in the first report. Francis runs a warehouse for medicinal plants and is most likely the largest supplier of cat's claw (*Uncaria tomentosa*, Rubiaceae) in the Pucallpa area. Francis recently had purchased 586 hectares of land near Chanajao on the Ucayali River for a biodiversity project that will include large-scale cultivation of ayahuasca vine, as well as chakruna. As we learned on our first two trips, more people either are cultivating ayahuasca or have plans to grow the vine. In our conversations with people who trade plants, we learned that ayahuasca vine cultivation is very much on the minds of traders who see a long-term future market for ayahuasca.

To Lago Imiria

In April 2019, our team returned to the village of Junin Pablo on the Rio Tamaya, where we had visited in June 2018. The five-hour boat trip from Pucallpa to the village offered a thrilling display of wildlife, from many gray and pink river dolphins, to raptors, parrots, and herons, and even a sighting of a giant anteater. While most rivers have experienced a grave decline of wildlife, the Rio Tamaya has been devastated less than other nearby areas. I know that

The majestic Lago Imiria. Photo ©2019 Chris Kilham.



will change in time, as wildlife poachers concentrate more on that region. But for now, traveling that river affords a splendid view of fauna and flora.

Kleylie, who grew up along the Rio Tamaya, had called a few friends and family before our departure from Pucallpa and had received word that many robberies were happening on the Rio Tamaya. The river is busy with loggers, narcos (drug dealers), and robbers. We kept alert but encountered no problems as we rode along.

Once back in Junin Pablo, we checked into Hostel Lobo, an accommodation that offered basic shelter but little comfort. Kleylie located a woman nearby who would boil water for our morning coffee, and we learned how to raise buckets of water from a nearby well for morning bathing and to flush the dry toilet. We reconnected with two harvesters we had met previously: Matteo Teco and Antonio Cauper. Antonio has turned out to be one of our most reliable contacts, and we arranged to go into the forest with him to see wild harvesting of vine and observe the density of the vine.

Antonio and Matteo collect vine in two primary areas in the nearby forest. One area is near Lago Imiria, also known as the Imiria Lagoon. The other is Chauya, another body of water to the east of Imiria. Lago Imiria can be accessed readily by cutting the profuse lilies that grow all around its borders. Chauya is more difficult to reach because the floating waterway borders open and close constantly. Antonio told us that he has gone to Chauya a few times to collect vine, only to wind up lost, as the waterways he traveled to get there had disappeared in a day.

According to both Matteo and Antonio, Lago Imiria has a good amount of vine. But Chauya, they both say, is far richer in vine. Matteo says that he prefers to harvest in Chauya, while Antonio favors Lago Imiria. Both commented that while the forest areas around both Lago Imiria and Chauya contain a super abundance of ayahuasca vine, it is not possible to harvest just anywhere, as the forests are populated by narcos who work plots of coca (*Erythroxylum coca*, Erythroxylaceae), which are five to 15 hectares in size, and cook the coca in the jungle. The narcos have automatic weapons and jealously guard their plots. Antonio says that he occasionally lets the narcos know that he is a local harvesting vine nearby in the forest.

Early on a Friday morning, we got into our boat with Antonio, his son Nixon, and his daughter Sabina. Armed with machetes, oranges for snacks, and bags for carrying out wild fruits, we headed for Lago Imiria. In a sparsely populated region, Imiria is a majestic body of



Top image: The porter loads vine onto a moto.
 Middle image: A truck loaded with cat's claw at Francis Chauca's warehouse.
 Bottom image: A porter carries vine from a rapido.

water, sparkling clean and with abundant fish and birds. The lake is 22 km long and approximately 0.6 km wide, is part of a 135,000-hectare Area of Regional Conservation, and is home to mahogany (*Swietenia* spp., Meliaceae) and cedar (*Cedrus* spp., Pinaceae) forests, 15 islands covered with vegetation, and a wealth of ayahuasca vine. The shores of the lake are dense with aquatic plants including the reddish yellow imiria lily, after which the lake is named, plus an abundance of lotuses (*Nymphaea* spp., Nymphaeaceae). These shores move about, opening and closing lanes of travel.

After traveling on the glistening lake for a few miles, we nosed into an open spot on the shore and tied our boat to a tree near a single cabin. Antonio knew the owner of the cabin and said that our boat and engine would be safe there.

As soon as we started to walk toward the forest, we spotted several ayahuasca vines, but the vines were young and of no interest from a harvesting perspective. Hiking single file into dense forest, we followed Antonio for more than 40 minutes or so. We began to see an abundance of large, older vines. Antonio estimated the age of each vine as we examined them one after another, declaring one eight years old and another 40. In every direction, we encountered mature vines, many of them bearing literally tons of thick branches. Pointing to a very large thick vine, Antonio commented that he would not cut the main vine, because it is a “mother” vine. He would cut only branches, which were excellent for making ayahuasca. He also commented that the density of vines in Chauya was appreciably greater than what we were seeing in the forest around Imiria.

Antonio says that he goes into the forest about once every month, often with two or three helpers, gathering an average of 20 bundles of vine at a time. Though we saw no snakes during our time in the forest, we were besieged by mosquitoes, and wound up covered with very tiny ticks.

We hiked around the forest for a few hours and encountered an endless number of mature ayahuasca vines, most growing very closely to others. We rarely had to walk more than 10 meters to find another vine. Several vines were as large around as my arm, and a couple were double that thickness. Over the course of a few hours, we easily saw several hundred tons of living vine.



When we had seen enough, we started on the trail back toward our boat. Along the way, we encountered a giant *ungurahui* (*Oenocarpus bataua*, Arecaceae) tree. Antonio decided to cut the tree down, to collect the large purple drupes that are similar in appearance and taste to açai (*Euterpe oleracea*, Arecaceae) berries, only much larger. After Antonio brought the tree crashing down, we scooped up tens of kilos of fruits into cloth sacks, which we carried out of the forest to the boat.

Back in Junin Pablo, Nixon and Sabina had me stand shirtless while they located and removed dozens of sand grain-sized ticks from my torso, arms, and neck. I would find a few more when I returned home to the United States, when the ticks had become engorged with blood and were easier to detect.

Back in the village, Antonio asked me if I would consider being the godfather of his granddaughter Dalixa, the daughter of Sabina, who is only 18 years old. I asked him why he wanted me to do that, and he replied, “because you are a kind man.” I agreed, and we headed over to his house along the lake shore. There, Sabina prepared a bowl of water with some malva (*Malva* spp., Malvaceae) blossom hand-ground into it. Little Dalixa eyed me somewhat warily, but tolerated me applying the water to her hair and forehead while invoking “*en el nombre del padre, del madre, y del espíritu santo.*” After the quick little ceremony, we nibbled on ungurahui fruits and relaxed for a while.

The day after our forest hike around Lago Imiria, we headed back to Pucallpa, going with the current and making excellent time.

Summary

The four trips that our team has made in the departments of Loreto and Ucayali have given us a good current snapshot of conditions relative to the sustainability of ayahuasca vine. A great deal of cultivation is currently underway, and many of those with whom we spoke believe that cultivation is the only sustainable way forward. But for now, it appears that the supply of vine in the forest is sufficient to meet current demand.

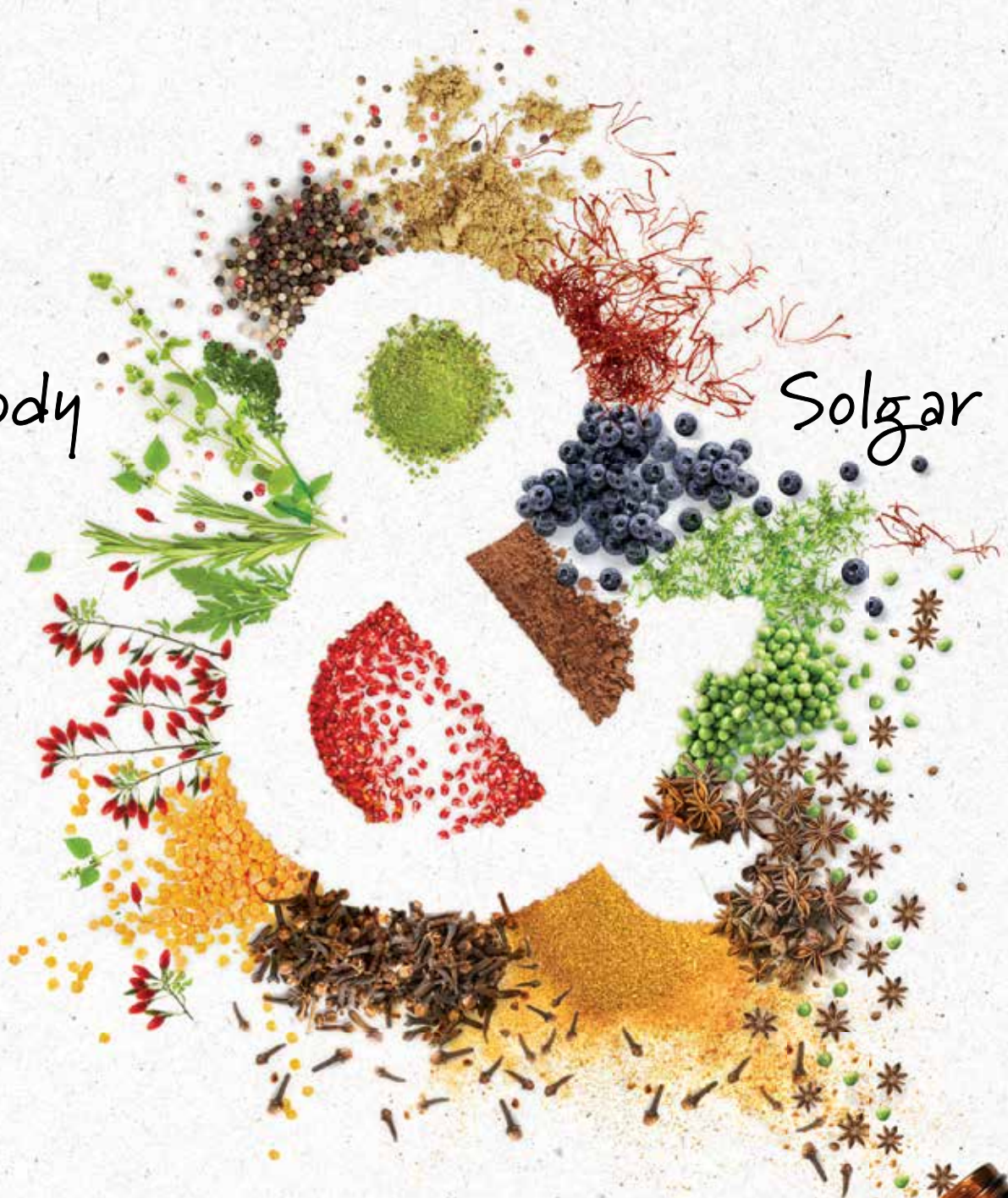
In choosing to assess the sustainability of ayahuasca vine in Loreto and Ucayali departments, I have taken on a project that has no end. It is my hope that the work we have undertaken thus far will serve as a foundation for others. Because ayahuasca is popular, and because export of ayahuasca brew is a significant trade, pressure on wild populations of ayahuasca vine will likely continue. At the same time, cultivation is increasing, and I believe that we will witness a great deal more of this over the next few years.

Many people made valuable contributions to this project. Sergio Cam, Jaime Baca, and Kleylie Vargas made this project possible and proved cheerful and resourceful companions. Antonio, Nixon, and Sabina Cauper helped us greatly in the forest. Matteo Teco and other villagers in Junin Pablo treated us with great hospitality and friendship and made us feel welcome during our stay. I am deeply grateful for everyone who has contributed to this work.

Sabina, Antonio, and Nixon Cauper with a large ayahuasca vine. Photo ©2019 Chris Kilham.

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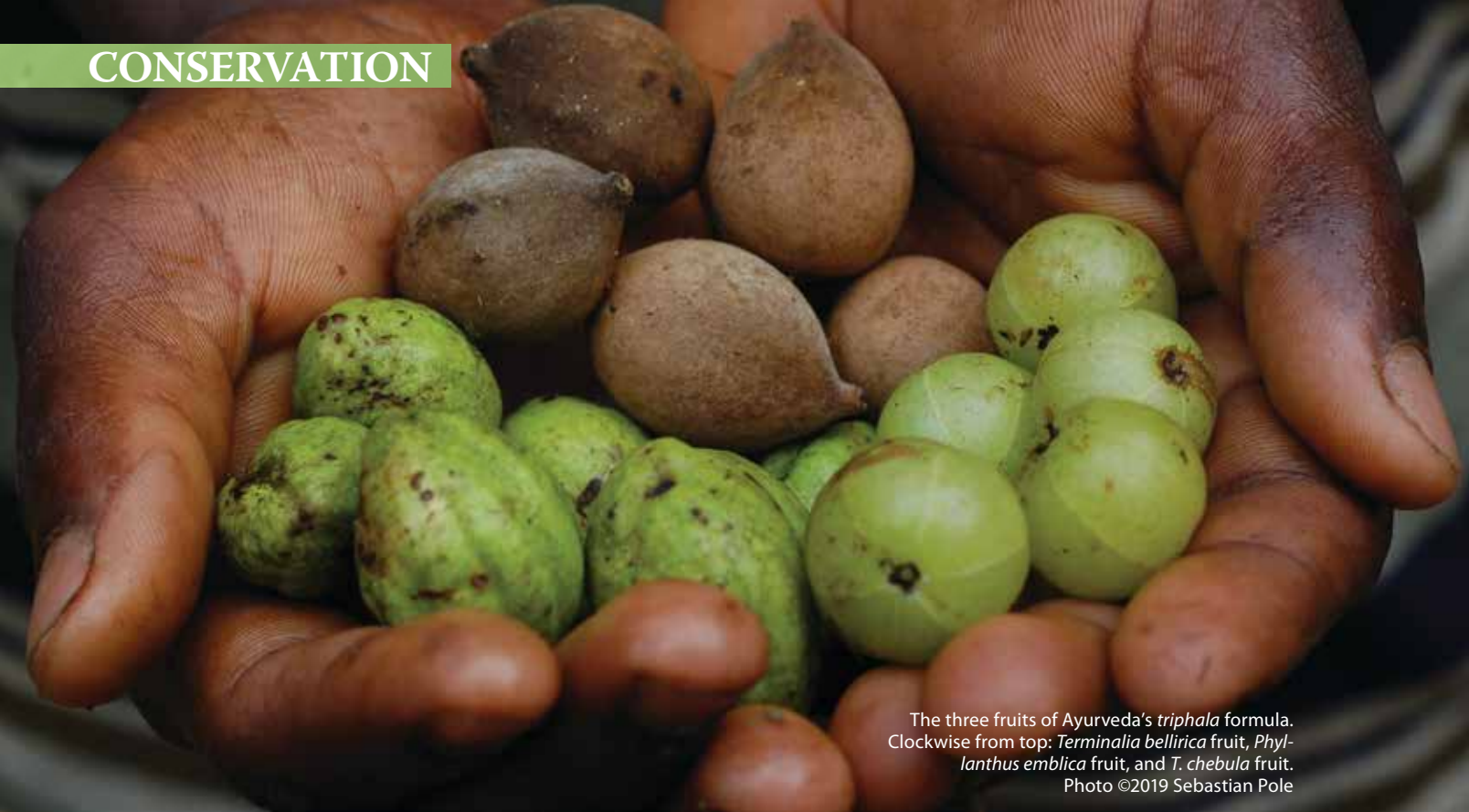
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The three fruits of Ayurveda's *triphala* formula. Clockwise from top: *Terminalia bellirica* fruit, *Phyllanthus emblica* fruit, and *T. chebula* fruit. Photo ©2019 Sebastian Pole

FairWild Project in India Is a Win-Win-Win for *Terminalia* Trees, People, and Hornbills

By Connor Yearsley

In the Western Ghats mountains of India, a FairWild Standard implementation project is benefitting plants, people, and animals. For local people, sustainably harvesting FairWild-certified fruits of belleric myrobalan (*bibhitaki*; *Terminalia bellirica*, Combretaceae) and chebulic myrobalan (*haritaki*; *T. chebula*), two medicinally and economically important tree species, has provided a better alternative to destructive and dangerous logging. And, unlike logging, harvesting the fruits provides a recurring benefit.¹⁻³

This FairWild effort also has protected nesting/roosting sites of two rare hornbill species: the great hornbill (*Buceros bicornis*), also called the great pied hornbill, and the Malabar pied hornbill (*Anthracoceros coronatus*), both of which may eat the *Terminalia* fruits and disperse the seeds.* The certification project demonstrates the potential social, ecological, and health-bringing benefits of the FairWild Standard.¹⁻³

According to Josef Brinckmann, research fellow at Traditional Medicinals and member of the American Botanical Council (ABC) Advisory Board, it is important to understand that a standard is a set of rules in the form of principles, criteria, and performance indicators, with control points that can be audited by a third party to measure compliance.

“The FairWild Standard, in my experience, is the most rigorous voluntary sustainability standard (VSS), specifically designed for the sustainable wild collection of medicinal and aromatic plants, uniquely applying a whole-ecosystem approach that includes relevant criteria for environmental, economic, and social sustainability,” wrote Brinckmann, who has helped implement the standard around the world (email, April 11, 2019).⁵

“Its implementation supports sustainable production and trade, quality assurance, biodiversity conservation, and resilient rural economies, while rewarding the wild-collection communities for functioning as stewards of sensitive ecosystems,” he added (see “In-Depth: The FairWild Standard” sidebar).⁵

* Photographic evidence indicates that the great hornbill eats the *Terminalia* fruits and disperses the seeds, and it is assumed that the Malabar pied hornbill also does this, according to Jayant Sarnaik, founding member and joint director of the Applied Environmental Research Foundation. Hornbills, in general, have been called “farmers of the forest” because they are highly effective at dispersing seeds of rainforest trees. They cover large areas to find enough fruit to eat and reportedly do not destroy the seeds, like many animals do. Smaller seeds pass through the hornbills undigested, while larger seeds are regurgitated and spit out.⁴

Both *T. bellirica* and *T. chebula*, the target species of this project, are medium-sized to large deciduous trees with small fruits (drupes). The fruits of these species are two of the three ingredients of the *triphala* (“three fruits”) formula, along with the fruit of amla (*Phyllanthus emblica*, Phyllanthaceae). Triphala is one of the most important and commonly used formulas in India’s traditional medicine system of Ayurveda and has been used for more than 1,000 years for many purposes, including as a digestive aid. Human clinical trials have shown that the formula has antidiabetic and anti-obesity effects and can reduce abdominal pain, constipation, flatulence, hyperacidity, and mucus.^{6,7}

In January 2019, the American Herbal Pharmacopoeia (AHP) released a monograph and therapeutic compendium for the fruit of *T. bellirica*, and it is working on monographs and therapeutic compendia for the two other triphala ingredients and triphala itself, which AHP claims will be the first in a Western pharmacopeia.^{8,9}

Based on a 2018 assessment, the great hornbill is considered vulnerable according to the Red List criteria of the International Union for Conservation of Nature (IUCN), meaning it is “considered to be facing a high risk of extinction in the wild.”¹⁰ The species mates for life. When the female is ready to lay eggs, she finds a large tree cavity, often in riverine habitats, and is sealed into the cavity with a wall made of feces and other materials. As she incubates the eggs, the female depends completely on the male to feed her and the offspring through a small opening left in the wall. If anything happens to the male during this time, the family is doomed, but this nesting strategy provides nearly complete protection from predators of eggs and hatchlings. One of the few trees big enough for the nest is *T. bellirica*, and the great hornbill reportedly obtains water entirely from the fruits it eats, including *Terminalia* fruits.^{3,4,11}

Based on a 2016 assessment, the Malabar pied hornbill is considered near threatened according to the Red List criteria of the IUCN, meaning it “is close to qualifying for or



The FairWild-certified harvesting areas for *Terminalia bellirica* (in Ratnagiri district) and *T. chebula* (in Pune district)



Great hornbill *Buceros bicornis*
Photo ©2019 Thipwan

Botanical illustration of *Terminalia chebula* from W. Roxburgh, *Plants of the coast of Coromandel*, Vol. 2. (1798)

is likely to qualify for a threatened category in the near future.”¹² This distinctive black-and-white bird has a large yellow and black beak that is topped with its oversized casque (a hollow structure that allows its calls to resonate through the dense forest habitat). Although its name may imply that its range is limited to the Western Ghats, it also is found in parts of central and eastern India and Sri Lanka.^{12,13}

The Project

In 2010, the Applied Environmental Research Foundation (AERF), a conservation non-governmental organization (NGO) based in Pune, Maharashtra, India, began to consider the FairWild Standard as a way to address important biodiversity conservation issues. Since 1996, AERF has conducted conservation projects in the northern Western Ghats, a global biodiversity hotspot.^{1,14} The Western Ghats is a mountain range that stretches about 1,000 miles along the western coast of India and contains a large proportion of the country’s biodiversity, much of which is not found anywhere else in the world. In fact, about a third of the plant species known in India are found in the northern part of this range.¹⁵

AERF previously determined that about 95% of the forest area (about 9,000 square kilometers, or 3,475 square miles) in the northern Western Ghats was owned and managed by local communities. Because of remoteness, a lack of economic opportunities, and a lack of knowledge about the importance of biodiversity conservation, these communities often identified logging as their preferred livelihood option, which has resulted in extensive forest degradation and biodiversity loss.¹⁴

In 2007, according to AERF, it launched India’s first incentive-based forest conservation initiative. With help from donors, AERF’s “MyForest” initiative offered farmers a financial incentive to stop logging. At first, many community members were confused that they could receive benefits for not logging, but the initiative eventually caught on.¹⁴ Now, through conservation agreements, AERF has secured protection for about 2,400 hectares (9.3 square miles) of



Great hornbill *Buceros bicornis*
Photo ©2019 Köln Zoo

Opposite page:
Belleric myrobalan *Terminalia bellirica*
Photo ©2019 Max Major



forest in the northern Western Ghats until 2027, according to Jayant Sarnaik, founding member and joint director of AERF (email, May 9, 2019). But AERF needed to create financial self-sufficiency to sustain its conservation efforts for the long term and turned to the FairWild Standard as a potential solution.¹

Further motivation came when United Kingdom-based Pukka Herbs, which specializes in organic herbal teas and supplements, expressed interest in purchasing FairWild-certified fruits of *T. bellirica* and *T. chebula*. AERF was encouraged by this partnership and inspired Pukka Herbs to also participate in the MyForest initiative by conserving 50 acres of private forests in the village of Wadi Adhishti in Ratnagiri, Maharashtra.^{1,14}

AERF identified two areas for possible implementation of the FairWild Standard. First, the Bhimashankar Wildlife Sanctuary in Pune district is known for the collection and sale of *T. chebula* fruits by the Mahadev Koli, the local

tribal community. Second, the forests of Sangameshwar in Ratnagiri district are rich in populations of *T. bellirica* trees, many of which are located in sacred groves that are valued for their religious significance. These groves are important for biodiversity colonization and act as “stepping stones” for species that pass through the landscape.¹

In 2013, the Darwin Initiative, a UK government grants mechanism that helps protect biodiversity and the natural environment through locally-based projects worldwide, awarded three years of support for the FairWild project, which enabled the University of Kent’s Durrell Institute of Conservation and Ecology (DICE) to study the ecology of the area. A smaller grant from Keidanren Nature Conservation Fund also was awarded to TRAFFIC, an NGO that works globally on wildlife trade issues, to support this project. These funds allowed AERF to purchase and install equipment for processing (drying and pulverizing) the fruits. They also allowed AERF to conduct situation analyses, training sessions with the local communities, and trial collection exercises.¹

At the same time, AERF established a for-profit entity, Nature Connect India Pvt. Ltd., for conducting transactions related to the manufacturing and sale of the FairWild-certified processed material. AERF and Nature Connect recognized that the FairWild premium, a percentage of the value of the product that is returned to the community for its development needs, could be used to build biogas plants (thereby reducing the need for the collection of firewood) and/or improve sanitation, for example. This would encourage conservation of the natural resources.¹

Pukka Herbs’ Sustainable Herbs Manager Ben Heron worked extensively with Nature Connect for years to help coordinate with stakeholders and implement the necessary good agricultural and collection practices (GACPs) to assure that the *Terminalia* fruits meet the standards of the British Pharmacopoeia and now the AHP, along with organic and FairWild training and certification (email from Sebastian Pole, co-founder and Master Herbsmith of Pukka Herbs, May 2, 2019).

Because of AERF’s previous work in the northern Western Ghats, it had established valuable relationships with the local people and understood many of the biodiversity and socio-economic factors. Through surveys, AERF confirmed that villagers in the



Malabar pied hornbills
Anthracoceros coronatus
 Photo ©2019 Petr Simon

In-Depth: The FairWild Standard — A Q&A with Josef Brinckmann

What are the main stipulations of the FairWild Standard? Which of those are most important?

JB: All of the main stipulations are important and support each other. First, a risk assessment must be carried out on the target species for collection in order to determine whether the species will be managed as a high-, medium-, or low-risk plant. Then, a resource assessment is carried out for the entire mapped area where the collection will occur. The resource assessment considers not only the target species but all species that occur in the managed area. If it is determined that a threatened species occurs in the managed collection area, whether flora or fauna, the eventual management plan must prescribe collection practices that will not be detrimental to the long-term survival of the threatened species in the habitat. If a threatened or endangered animal shares habitat with the wild plant collection area, then additional wildlife-friendly criteria may need to be developed to augment the plan.

Both the risk and resource assessments inform the development and implementation of an adaptive management plan. At this point, it is known what the maximum optimal yield per year can be, the regeneration rates, and other special considerations for capacity building and training of the harvesters. Part of the management plan involves periodic monitoring and evaluation. This may lead to adapting the management plan to any observed changing conditions, such as impacts of increasingly extreme weather events. Finally, successful use of the standard depends on annual audits carried out by trained inspectors from accredited independent third-party control bodies, as well as trading and labeling rules for the finished product brands.

Can the standard be applied universally to any wild plant? Why or why not?

JB: In the years preceding the publication of version 1.0 of the FairWild Standard in 2006, drafts of the standard, as well as a precursor standard (the International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants [ISSC-MAP]), were test implemented internationally with a diverse range of plant species, situated in all different ecosystems, from the Amazon and the Andes, arid zones in Africa, forests and meadows of southern and eastern Europe, and steppes in floodplains of Asia. It was indeed important to determine and prove a global applicability of the standard. The precursor ISSC-MAP was merged into the FairWild Standard version 2.0 in 2010.

What can be said about the accountability that the FairWild Standard creates, since retaining the certification seems to depend on all community members?

JB: I don't actually think that the FairWild Standard is designed to hold wild-collection companies and/or their employees or members accountable. Holding collectors accountable sounds like policing, which is not what it is all about. Of course the individual collectors undergo capacity building and training (on the requirements of the standard), but the ones really being held accountable are the product brands that use the ingredients. Most wild collectors I've met take great pride in their work, and everyone in the village knows each other personally. If one person is jeopardizing the income of 99 others, the situation will be resolved. In any case, there are much bigger problems for wild collectors and small farmers. One of the biggest problems today is how widespread nonpoint-source pesticide contamination has become, globally. Wild-collection operations in the most remote locations on the planet have to contend with occasional market rejections due to detection of pesticide residues of unknown origin, due to long-range

atmospheric transport. The other big problems include alarmingly rapid loss of biodiversity across the planet (from wild land conversion to farming or grazing, for example), urbanization, and mass migration of youth from rural to urban areas. The rural wild-collection communities are aging, and very few young people are staying to continue the tradition of wild collection of medicinal plants for local medicine and trade.

Why has the standard not been implemented more widely? What are the main barriers to its implementation?

JB: Being a member of the FairWild Foundation board of trustees since 2008, I must admit that I have been disappointed in the relatively low interest and uptake of the standard by industry. But I get it. It is not easy, and the public is not demanding it. In the meantime, many other "easier" voluntary sustainability standards (VSSs) have been developed and have become applied more widely. There is a bigger market for "sustainability lite."

In my view, however, even if a brand is not interested in sustainability marketing and use of the logo on labeling, which certifies that the ingredients are produced in compliance with the standard, it makes good business sense to use the available tools and guidance (e.g., the resource assessment and management plan guidance). Implementing the standard and using the tools give all stakeholders in the value chain (the wild harvesters, processors/suppliers, and finished product brands) data that are really useful for long-term planning, quality assurance/control, and supply chain risk mitigation. I view implementation of the FairWild Standard as relatively inexpensive insurance. The data inform planning and reduce uncertainty, especially for fast-growing companies.

How financially viable is the FairWild Standard?

JB: Financial viability of implementing the FairWild Standard has to do with the size of the operation and annual quantity of plants harvested. It would not be economically viable for a micro-enterprise that harvests only five to 10 tons annually, but it can be economically viable for a small to medium-sized enterprise that is harvesting 50 to 100 tons annually, also depending on the market value of the botanical itself. Almost all FairWild-certified operations in the trading system were already inspected and certified for compliance with an organic wild-crop harvesting practice standard. If an operation is already familiar with the requirements of complying with organic regulations, adding on the FairWild Standard is not as complicated. However, the operation will still need a dedicated person for compliance with standards. This person manages the audits and post-audit corrective action measures, as well as the ongoing monitoring and evaluation of the collection area, periodic revision of the management plan as more is learned, and annual training of the qualified collectors.

There are fixed costs (the fees charged for the annual inspection and certification), which can be considerable, especially for remote operations, if the inspector needs to travel from another country and spend several work days in the field for the audit. It should also be noted that the FairWild Standard requires that collectors are paid higher-than-normal farmgate prices and are also recipients of premium fund monies, which the collectors can use for the purpose of improving the quality of life in their communities and households. Decisions on use of the funds are to occur through a democratic process. The FairWild operators I visit around the world are genuinely appreciative of the additional funds that help them lead more dignified lives in the very hard work of wild harvesting plants day in and day out.

“Lastly and more importantly, with scaling up of the FairWild-certified value chains, at least for the target species of our projects, positive impacts for biodiversity conservation grow multifold. This is on the grounds that the entire resource area gets certified, resulting in conservation of many other plants and animals. All this makes the project unique.”

Bhimashankar Wildlife Sanctuary depended mostly on rice (*Oryza sativa*, Poaceae) cultivation for their livelihoods, but also depended on income from other sources, of which *T. chebula* fruits accounted for about 50%. Similar information was gathered at the other site in Sangameshwar.¹

In 2015, the first year of FairWild certification, 2.6 metric tons (MTs) of *T. bellirica* fruit and 3.6 MTs of *T. chebula* fruit were collected under the standard. In 2016, 4.6 MTs of *T. bellirica* fruit and 4.9 MTs of *T. chebula* fruit were collected.¹ And, in 2018, 5 MTs of *T. bellirica* fruit and 4.5 MTs of *T. chebula* fruit were collected, according to Sarnaik. Significant quantities of semi-processed fruits were delivered to Pukka Herbs (3.2 MTs in 2015 and 4.4 MTs in 2016), and the company uses the FairWild- and organic-certified fruits in its triphala capsules, turmeric (*Curcuma longa*, Zingiberaceae) active tea, and lean matcha green tea (*Camellia sinensis*, Theaceae).¹

Albuquerque, New Mexico-based Banyan Botanicals, which specializes in Ayurvedic products, purchases some of the FairWild-certified fruit powder from Pukka Herbs and uses it in its triphala tablets. “We would also like to use FairWild-certified *Terminalia* fruit powder in other products, but the supply is still increasing, as the scope of this project continues to expand to other communities in the area,” wrote Devang Shah, chief operating officer of Banyan Botanicals (email, April 10, 2019).

According to Sarnaik, the demand for the FairWild-certified value chains that AERF established is growing by about 300% each year. This requires bringing more areas under certification. For example, in the first year (2015), there were six certified resource areas in Sangameshwar for *T. bellirica*. There are now 12 resource areas for *T. bellirica*, and at least two more will be added in 2019. The project is taking place on about 200 hectares across all the sites. In the case of *T. chebula*, the land is owned by the local communities, and in the case of *T. bellirica*, the land belongs to the government. “For both value chains, the land is not legally protected, and there are multiple threats to these lands and the resources within,” Sarnaik wrote (email, April 1, 2019).

The collectors are told to harvest a maximum of 70% of the fruits from each tree and leave at least 30% for regeneration, according to Sarnaik. “In any case, it is practically impossible to harvest all the fruits, as the trees of *T. bellirica* are quite tall and old,” he wrote. In the case of *T. bellirica*, old trees fruit in alternating years. For *T. chebula*, all the trees fruit every year, but the changing climate has an impact on harvest levels. “Sustainable harvesting practices are well documented for both species, and collectors are trained every year so they remember the dos and don’ts of harvesting,” Sarnaik added.

The FairWild project is safeguarding about 2,000 *T. chebula* trees and 500 *T. bellirica* trees. Because the trees are wild, they do not require heavy maintenance by the local communities, but the “sustainable management of the resource area is key to high-quality fruit production,” Sarnaik wrote. Currently, the project is also saving three nesting sites of the great hornbill and six nesting/roosting habitats of the Malabar pied hornbill. One hornbill nesting site typically supports one offspring each year, according to Sarnaik.

Sarnaik thinks this project is significant and unique because it has attracted attention and ensured participation of many stakeholder groups, including

Terminalia chebula collector in the Bhimashankar Wildlife Sanctuary
Photo ©2019 Sebastian Pole



local communities, businesses, academic institutions and individual researchers, nonprofits, and government institutions. In addition, it may be one of the only projects “from the forest-based value chain sectors in which the communities at the grassroots level gained access to the global market for adopting good practices and sustainable biodiversity use,” he wrote.

“Lastly and more importantly, with scaling up of the FairWild-certified value chains, at least for the target species of our projects, positive impacts for biodiversity conservation grow multifold,” Sarnaik continued. “This is on the grounds that the entire resource area gets certified, resulting in conservation of many other plants and animals. All this makes the project unique.”

Shah noted that “the project is a great example of how one company’s commercial need can provide opportunity where one may not have existed before. In this case, we have a need for high-quality *T. bellirica* and *T. chebula* fruits. This project supports local communities to collect these fruits, which are not as valued in the local market, in hopes that the increased income is a better and more sustainable alternative to cutting the trees for wood.”

Locally, low-quality fruits may sell for less than a dollar per kilogram, according to Shah. “Whereas we can pay a premium in this case, due to the higher quality of these fruits,” he wrote. “For this project, the forest areas have been certified organic along with the FairWild wild-collection practices.”

Pole noted that “with approximately 25% by volume of all herbs used in the herbal industry coming from the wild [according to some estimates], it is vital that we have more sustainable certification for wild harvesting projects. FairWild is the best standard for this in the world” (email, March 26, 2019).[†]

According to Pole, the FairWild Standard also provides a framework to ensure the fair and equitable sharing of benefits that arise from the use of genetic resources, as required by the Nagoya Protocol on Access and Benefit Sharing (ABS) of the Convention on Biological Diversity (CBD) (email, April 16, 2019).

The Western Ghats project is creating interest among indigenous communities from other areas, according to Sarnaik. “It is likely that we will implement [similar projects] at other locations,” he wrote. “For example, we intend to develop a FairWild value chain for *Madhuca longifolia* [Sapotaceae] fruit.”

Sarnaik said it was challenging to deal with the learning curves and priorities of the different stakeholders who were involved in this project. “It takes lots of patience, perseverance, and negotiation skills to address these challenges,” he wrote.

For more information about this FairWild project, videos that give an on-the-ground perspective from the wild collectors in India are available on the Sustainable Herbs Program website.¹⁶ HG

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[†] According to the June 2018 TRAFFIC Report, 60-90% of medicinal and aromatic plant species in trade are wild collected,² but Pole thinks that volume is more indicative of the pressure being placed on natural resources.

The Potential of **BLOCKCHAIN** for Herbal Supply Chain Management

By Karen Raterman

With a supply chain as vast and varied as that of the herbal products industry, it is not surprising that transparency and traceability for herbal ingredients have become primary considerations for herbal suppliers and manufacturers. Strides have been made in recent years to increase traceability of herbal ingredients from farm to store shelf, but ingredients may still become compromised, which leaves the industry subject to potential negative publicity and reduced consumer trust.¹ In this context, some people believe that the industry standard of trust and verification could benefit from an emerging technology known as blockchain.

Vulnerabilities in the supply from adulteration and mishandling to overharvesting and substitution are well documented.² Companies that are vertically integrated with captive manufacturing and their own procurement and sourcing often can provide traceability all the way back to farms, but some companies, such as those that work with contract manufacturers, for example, may have more complicated systems of operation.

“Some companies go above and beyond, but a lot of distributors and other companies still have not figured out their supply chain,” said Len Monheit, managing partner for Trust Transparency Consulting (oral communication, March 18, 2019). However, he noted, companies that don’t have their own manufacturing facilities or vertical integration are more likely to have issues with their supply chain.

Many industrywide efforts have tried to identify and address these challenges through knowledge sharing. In 1990s, for example, the American Botanical Council (ABC) initiated the Ginseng Evaluation Program and published information on adulterated products that were labeled to contain “ginseng” (*Panax* spp., Araliaceae). Also in the 1990s, the American Herbal Products Association (AHPA) published herb safety data and labeling guidance in its *Botanical Safety Handbook*.^{3,4} More recently, the ABC-American Herbal Pharmacopoeia (AHP)-National Center for Natural Products Research (NCNPR) Botanical Adulterants Prevention Program (BAPP) was created in 2010 to address the issue of botanical ingredient adulteration in global commerce and has published more than 50 publicly available documents on the topic.⁵

Most recently, the Supplement Safety & Compliance Initiative (SSCI), spearheaded by the Natural Products Association (NPA) with the support of retailers such as GNC, Walmart, Vitamin

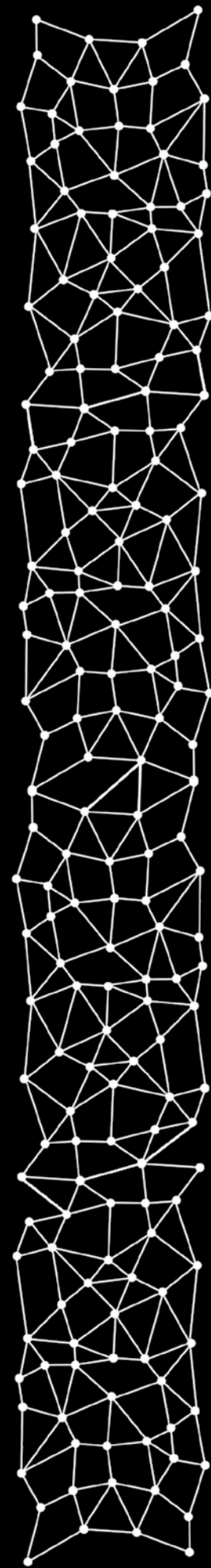
Shoppe, and Whole Foods Market, has worked to develop tools to simplify compliance with good manufacturing practices (GMPs). The SSCI aims to create benchmarks and standardize the collection of supply chain information, while also providing a platform for stakeholder collaboration, knowledge sharing, and networking.⁶

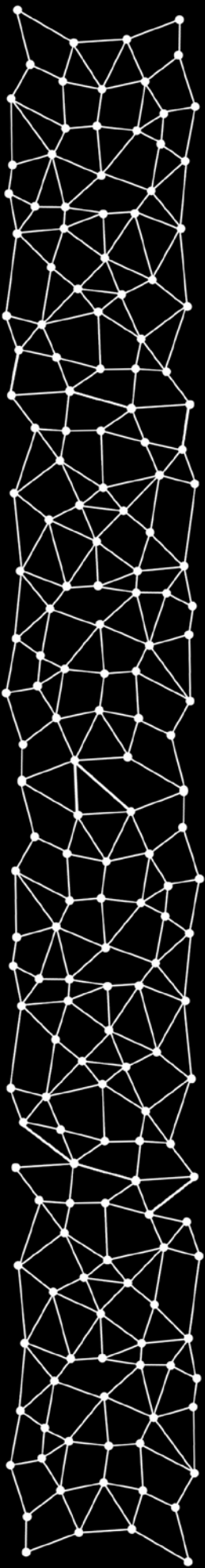
Despite progress, issues remain that leave some to wonder if blockchain could be the missing puzzle piece. There is growing interest in the technology in the herbal products industry, and, according to some experts, it may help solve some of the challenges that companies are facing with respect to tracking ingredients, verifying certifications, and providing transparency and trust in products.⁷ Though no one can predict exactly how this situation will play out, many industry stakeholders believe that blockchain is coming — the question is when and how.

What Is Blockchain?

Blockchain technology is actually not new, having first been developed in the early 1990s. Its first widespread application came in 2008, when it was used to trace cryptocurrencies like Bitcoin.⁸ Essentially, blockchain is a public record of transactions, and whenever someone makes a transaction, it is uploaded to a shared network or database. This chain of linked transactions is the blockchain. Because these transactions are stored in a decentralized network, blockchain is considered secure, unchangeable, and even “unhackable,” and experts see it as having the potential to revolutionize supply

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Explaining Blockchain

In simple terms, blockchain is a unique system used to track economic transactions. It is a digital ledger in which “blocks” of data are bound together in a “chain” and secured using cryptography. It is an immutable record of data that is managed by a cluster of computers that are not owned by any single entity. According to some, this technology has the potential to revolutionize supply chain tracking and traceability in various industries.⁸

chain management across many industries.⁸ Blockchain is already seeing adoption beyond the virtual cryptocurrencies to physical supply chains, including those for ingredients in foods and pharmaceuticals.

In general, blockchain is seen as offering a number of important advantages. It is transparent, secure, and provides a digital, streamlined process for consistent and speedy data tracking, as well as complex solutions for analyzing uploaded data.⁸ However, it also has disadvantages. It is complex and challenging to learn and use; because it is global in scope, it ultimately requires compliance with international laws and standardization; and it has a network effect, which only gains value if it grows in users.⁸

Peeling Back the Layers

A few herbal companies already are using the technology, but many more have expressed interest in it.

“Blockchain technology will become an integral part of all supply chains, because it allows for secure and immutable information storage,” wrote Wilson Lau, vice president of Nuherbs (email, February 26, 2019). “So everyone is looking into it, from shipping companies, for tracking the containers in which herbs and herbal supplements travel, down the pipeline to retailers who are demanding it. For example, Walmart is mandating that all its leafy greens suppliers upload their data to their

blockchain by September 2019.” The mandate is part of the Walmart Food Traceability Initiative announced in 2018, which is designed to increase transparency in the food system and create shared value across the leafy green supply chain.⁹

Blockchain does not necessarily replace any technology that has come before, but it is a new way of doing things, said Gary Nowacki, CEO of TraceGains, a cloud-based supplier of compliance and quality management solutions for the food, beverage, and supplement industries (oral communication, March 14, 2019). “Its fundamental premise is that it will take whatever data that you track and store it in a distribution ledger across servers to make the data immutable, so nobody can falsify it.”

Blockchain is gaining interest for tracking physical items in a supply chain, such as a head of lettuce or the salmon one might purchase in a supermarket to verify that it was ocean-caught. However, using blockchain becomes a lot more complicated in a multifaceted supply chain with multi-ingredient products.

“While it may be feasible to track a piece of salmon from the ocean to the supermarket, it is [significantly] more complex to track all the ingredients that went into the formula for a specific [dietary] supplement,” Nowacki said. This would involve many steps, including tracking the field where the botanical harvest took place, all the people who touched it or transported the ingredient, the packing, processing, and compounding

Blockchain is already seeing adoption beyond the virtual cryptocurrencies to physical supply chains, including those for ingredients in foods and pharmaceuticals.

The technology may help provide sustainable sourcing and quality assurance and tackle supply problems for complex multi-herb preparations.

facilities, and potentially any temporary ownership by a broker, importer, or distributor. “Then you would have to do all of that for all the other ingredients that went into that capsule,” Nowacki said.

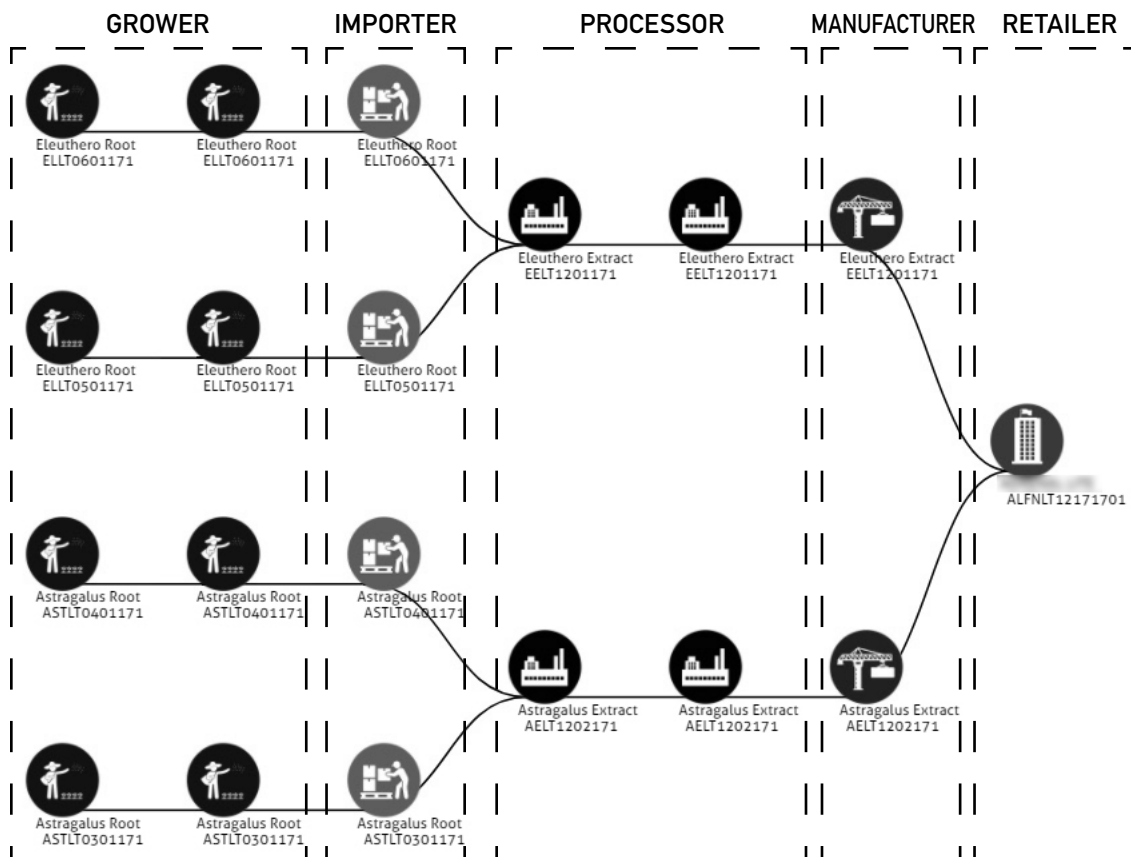
A recent paper from the University College London School of Pharmacy and the University of Westminster School of Life Sciences in London explored the role of blockchain systems in high-value botanical supply chains. The authors of the paper note that the technology may help provide sustainable sourcing and quality assurance and tackle supply problems for complex multi-herb preparations.¹⁰ According to the paper, in these supply systems, there are specific and unique concerns due to the core characteristics of the botanical supply chain. For example, raw materials can be wild or cultivated; a large number of primary producers use very small quantities of raw materials; middlemen often link international purveyors of herbal ingredients; regulations vary in markets around the world;

and some involved parties lack knowledge about threatened or overharvested species. According to the authors, these factors lead to concerns regarding “equitable benefit sharing, responsible sourcing and sustainable supply as it relates to protected or threatened environments.”

The UK paper suggests that blockchain systems, particularly closed systems, address some of these challenges by providing a safe and trusted platform for interaction without the need to build trust among individual parties, and it may also help save time and money by eliminating the need for third parties to mediate disputes.¹⁰ “It is a big onion with lots of layers,” said Sara Newmark, vice president of social impact for MegaFood, which has documented connections with its suppliers both locally and internationally. “It is very complicated at times to understand each and every aspect of our supply chain,” she added.

Some companies that already have strong supply chain traceability in place are cautiously optimistic about block-

TagOne’s Visual Map provides a visual tracking of ingredients and supplies, from seed to shelf, all blockchain enabled. Graphic courtesy of TagOne.





Key data points are captured and validated using blockchain at each stage of the supply chain. This example shows how turmeric can be tracked with a QR code from seed to shelf. Graphic courtesy of TagOne.

chain. Chinese herb supplier Nuherbs, for example, buys many of its herbs from farmers and wild collectors and interacts closely with facilities to make certain the materials are processed to meet its rigorous specifications and adhere to traditional Chinese medicine (TCM) principles, while applying modern technology to ensure quality.

“Blockchain won’t change or necessarily enhance what Nuherbs currently does, since we already have a lot of insight, from origin to our warehouse, through our work with the growers and wildcrafters of our herbs,” Lau said. “But with blockchain, all information would become fully digitized at all stages and be faster than how it’s done now, which has great potential. Blockchain would give us even more insight in the logistic end of things, specifically where, [by whom], and how it was handled.”

Similarly, because herbal tea manufacturer Traditional Medicinals is buying organic raw materials, it already has traceability back to the field, said Ben Couch, the company’s sustainability manager (email, February 12, 2019). “It is also the case that we are not buying widely traded commodity quality that would be in a mass balance* or generic supply context with multiple supply or process options that would necessitate a distributed-ledger traceability. So it hasn’t been a top priority for discussion compared to the more basic supply and logistics planning we’re focused on.”

However, some companies do see a significant upside. “I am speaking from the framework of a B Corporation and a transparency role,” said Newmark, whose company, FoodState (MegaFood), is a certified B Corporation. “From a transparency standpoint or ethical mission of uplifting

communities and tackling the climate crisis, we have an opportunity to [compose] our supply chain of smaller farmers who can make change happen faster. But the herbal supply chain has multiple layers between the brand and the farm, so we have to have things in place to peel the onion.... Blockchain is definitely providing a lot of opportunity to have the world connect in a way that is very powerful,” she said.

Couch also believes there are strong opportunities in specific supply chains and fair trade premiums. “Certified materials like FSC [Forest Stewardship Council]-certified wood or filter paper could benefit from blockchain, so we could know where the fiber is coming from for annual tracking and long-term risk assessment,” he said, adding that fair trade and FairWild premium spending is not consistently reported by producers up through suppliers and companies. Blockchain could conceivably be used to track these payments so brands could see, for example, where the fair trade ginger (*Zingiber officinale*, Zingiberaceae) came from and what the farmer did with the premium. “This would be in a targeted manner, but certainly if blockchain were more widely implemented by major suppliers, it would enable a much stronger traceability platform, providing some of the UPC/barcode scan-based traceability that brands are rolling out.”

A Customized Option

When it comes to dietary supplements and herbs, the challenges remain endless, according to Anand Swaroop, PhD, FACN, president of Cepham, a manufacturer of

* A mass balance system is one in which a producer can obtain a fair trade certification for a specific ingredient, even though it may be mixed with conventional ingredients at the factory level.¹¹ It allows manufacturers, brands, and retailers to support the field impacts of certain certifications without the need to change manufacturing processes to comply with the requirements of a segregated supply chain.¹²

"When we started, we were taken aback by what was happening when it came to the approach of sourcing ingredients. We estimated the lack of transparency at between 90% and 95% for ingredients coming from outside of the United States."

herbal ingredients that claims to have been one of the first companies in the herbal products industry to employ a blockchain solution to its supply chain management (oral communication, February 15, 2019).

Cepharm is using the TagOne Farm to Aisle supply chain transparency solution, with a blockchain platform that was custom-designed for the dietary supplement space as a co-innovation initiative with Dreamweaver LLC, with the input of industry stakeholders through the SSCI effort. TagOne was put into complete operation in 2018, and the system is now online with visibility of the data backed by blockchain. "There were a lot of pitfalls, issues, and challenges to solve with the data. But somehow going through this we created a system that is working well now," Swaroop said.

It was a lengthy process. Development of the system first started in 2015 with the Dreamweaver team, which had previously worked in the pharmaceutical segment, looking into the supply chain challenges facing the supplement industry. "When we started, we were taken aback by what

was happening when it came to the approach of sourcing ingredients," said Trinanjan Gupta, founder and CEO of TagOne LLC (oral communication, February 21, 2019). "We estimated the lack of transparency at between 90% and 95% for ingredients coming from outside of the United States." Although some outlier companies know their farms and know where their raw material is coming from, the majority of companies do not, he said.

The TagOne team identified several key challenges for the supplement space: lack of visibility of source ingredients due to the global nature of sourcing; concern about the quality of raw materials due to ever-increasing demand but finite supply sources; increasing regulatory requirements; growing consumer awareness of product quality and health effects; and identifying a problem source quickly in the case of a recall or an adverse event.¹³

The TagOne platform covers all transactions in the supply chain including crop management, sales, purchasing, receiving, processing, shipping, and manufacturing across different partner roles (e.g., farmer, trader, proces-

PhytaZenica Startup to Use Blockchain Technology to Accelerate FDA Approval of Botanical Drugs

PhytaZenica is a health care technology startup company that intends to introduce a system using blockchain that will allow for global decentralized digital fundraising for the development of FDA-approved botanical drugs. The blockchain technology will be used to provide a platform for individual investors worldwide to support botanical medicines and quickly raise capital for clinical trials, FDA approval, and commercialization.

Many companies are producing botanical therapies that are more effective, safer, and less expensive than prescription drugs, but they are not getting the traction they deserve in the marketplace because of a system that is biased toward FDA-approved single-chemical prescription medications, according to Jennifer Wong, CEO of PhytaZenica (oral communication, April 12, 2019). "FDA approval is the standard," she said. "That is the culture of our system." Most physicians will not prescribe a therapeutic product that is not approved by the FDA. While use of integrative practitioners is gaining popularity, it is still relatively rare, she said. PhytaZenica's platform intends to offer consumers a form of socially responsible medicine and help provide funding for the medicines that consumers want to see introduced in the market.


Even in China, Wong said, where traditional Chinese medicine (TCM) is the medicine of the people, funding for these therapies is still a challenge. "In Chinese hospitals,

doctors are still trained in Western conventional medicine, so despite the fact that the government is trying to set up equal status for TCM with clinical trials and licensing, doctors are still reluctant to prescribe an unapproved product. Even big TCM companies are coming to the United States to conduct their clinical trials."

The PhytaZenica team saw an opportunity to create a platform that will provide funding and resources for these botanical therapies. The PhytaZenica model includes a blockchain fundraising platform on which botanical companies can raise capital from individual investors around the world.¹⁴ The company is developing a native digital currency called "phyta" to run the blockchain platform and an internal exchange for convenient trading and adoption of the ecosystem's tokens. The company will also provide assistance from FDA botanical drug experts in designing regulatory and clinical trial strategies.

As a secondary step, the company will develop decentralized apps to support botanical therapies and drugs, such as supply chain validation, Wong said.

Although the costs of developing an FDA-approved drug are disputed, current research estimates that a large pharmaceutical company might invest billions of dollars to develop a conventional drug,¹⁵ and it may take as long as 10 to 15 years to complete the process.¹⁶ Given that most botanical product manufacturers are comparatively small,



sor, importer, manufacturer, brand owner, distributor, and retailer).¹⁴ Gupta explained that it was developed around three key pillars: smart phones or tablets for capturing data; the cloud infrastructure to replicate the data; and blockchain technology to ensure that the data cannot be tampered with. “We use a global supply from [many] resources and places around the world that we don’t have easy access to,” Gupta said. “Farmers in China and Africa don’t know where their goods are going. We needed to make it easier for them to fill out the information. In this day and age, we have the technology to do this.”

Engaging farmers and providing practical solutions for them were particular challenges. Having determined that upstream partners like farmers, consolidators, and processors were more likely to use cell phones, the team designed an app that can be used to capture data and is available in English, Hindi, and Mandarin. The TagOne Harvest App offers a simple way for farmers to capture data as the seeds go into the ground and the crops are harvested, said Gupta. Capturing accurate data from farmers efficiently and inexpensively was seen as one of the key problems to solve by the TagOne team and prompted development of the Harvest App.

The app has full traceability and steps to identify plants from seed and field to shelf, according to Trish Flaster, executive director of Botanical Liaisons, who helped create the guidelines for the app. “It has 50 different plants listed with images, sensory evaluation, and information on the farmer, so we know who they are,” she said (oral communication, February 11, 2019). This can help identify issues: if the farmer puts in a longitude or latitude that does not make sense for that particular crop, for example, it would create a virtual red flag. “Knowing the location of the farmer gives the brand or manufacturer an added measure of reliability and trust,” she said.

While supply chain traceability and transparency are the current primary applications for blockchain, there may be other ways the technology can be useful in the botanical products segment. For example, an early-stage startup, PhytaZenica, is developing a blockchain-based platform to raise funding from individual investors for research, development, and regulatory approval of botanical drugs using a digital currency called “phyta” (see sidebar). The company believes that traditional fundraising methods for companies involved with the research and development of botanical drugs (per the US Food and Drug Administration’s

While supply chain traceability and transparency are the current primary applications for blockchain, there may be other ways the technology can be useful in the botanical products segment.

these costs can be prohibitive, according to Wong. The PhytaZenica solution, she said, provides a more affordable, realistic option, suggesting that the costs of clinical trials to develop botanical drugs are in the range of \$15 million to \$125 million, with a time frame to market that is significantly shorter at less than five years, according to company literature.

Money is raised as investors purchase the phyta currency to fund the initial infrastructure and technology and then investors can also support a particular botanical drug project, receiving tokens tied to that specific project. Drug tokens can be used to purchase approved botanical drugs or be purchased or traded with phyta on the internal exchange. PhytaZenica’s revenue stream will come from commissions for funds raised for botanical projects, token exchange transaction fees, royalties from future botanical drug sales, and strategic investments in promising therapies, among other things.

Botanical drug projects will go through four phases of development in the PhytaZenica ecosystem. The first is a due diligence process to identify botanical therapies with strong market potential that can show either solid clinical trial evidence and/or a track record of consumer use; the second is fundraising for and design of clinical trials to meet the requirements of FDA’s botanical drug approval guidelines¹⁷; the third is FDA approval and commercialization of the product; and the fourth is future royalties and investments.

The company will promote the concept to potential investors through digital marketing and social media. “This is about a grassroots approach and empowering the public to fund their own medicine,” Wong explained. PhytaZenica is currently in the early stages of fundraising for the platform and hoping to raise initial capital with the goal to launch the platform by yearend and the token exchange by early 2020, according to Wong. However, she noted that the blockchain venture environment is evolving very quickly, so a firm timeline is hard to predict.

“We do believe this is a good time to be doing this because of the current political landscape and all the excitement around health care in the 2020 election,” Wong added. “Many people bash ‘big pharma’ for high prescription drug costs. Our aim is to solve the health care crisis from a different angle. The concept of socially responsible medicine will trend well on social media and should resonate for people affected by a broken health care system that is not serving patients or the general public well. This is our way to [solve] the problem.”

In addition, the company believes the platform will contribute to a triple bottom line (People, Planet, and Profit) in that the venture supports the proliferation of botanical drugs, which in general are environmentally friendly, taking less time and money to manufacture and producing less chemical waste. In addition, the company plans to develop a supply chain validation app that may tie into environmental sustainability.

Beyond the complicated nature of herbal products and their supply chains, some central issues may need to be addressed before blockchain will see widespread adoption.

[FDA's] specific guidelines¹⁵) are time consuming and ineffective and, as a result, many botanical drug products are not getting the FDA approvals and eventual market introduction that they might otherwise warrant. "Supply chain validation is a focus, but not a number-one initial product launch for us because we believe the most urgent need is to drive capital and funding into the [botanical drug] industry," said Jennifer Wong, CEO of PhytaZenica (oral communication, April 12, 2019).

The team ultimately plans to develop apps that will operate on its proprietary blockchain platform. For example, customers, investors, or partners might use phyta tokens to access apps and services connected to the botanical drug supply chain to confirm the origin of botanical ingredients. The system could also be used for the secure sharing of botanical drug clinical data and medical samples with drug developers and FDA to increase the efficiency of the approval process.

Wong believes PhytaZenica's blockchain platform will be cost-competitive because it is highly scalable at 10,000 transactions per second and validates transactions in one second, which takes less computer power and electricity.¹⁵ There are many types of blockchain systems, Wong explained, and some are very wasteful. The PhytaZenica system is a decentralized consortium based on a proprietary software and licensing system. "Many companies are using 'old school' blockchain technology that is very slow and not scalable, with transactions taking about six minutes to validate," she explained. "It's not very realistic. No one wants to wait six minutes for a transaction to validate. The technology needs to be realistic and easy to use; otherwise people won't use it."

Not Yet Ready for Prime Time

To be sure, the capabilities of technology and availability of smart phones to solve ingredient tracking and supply chain issues have made significant leaps in recent years. Nevertheless, many companies are not yet ready to jump on board with blockchain. Beyond the complicated nature of herbal products and their supply chains, some central issues may need to be addressed before blockchain will see widespread adoption. For one, it is expensive. To give this some perspective, the cost per transaction for Bitcoin ranged between \$75 and \$160 in 2018, largely due to electricity use.^{18,19} This adds up. The electricity it takes for consumers every year to mint cryptocurrencies is roughly equal to the annual electricity usage of entire countries, such as Portugal or Romania.²⁰

"Until blockchain becomes less expensive, it is hard to envision a lower margin industry like food or dietary supplements embracing it," Nowacki said. "I am not saying it won't become less expensive, but until it does, if you are making a \$7.99 bottle of fish oil supplements, you don't want to spend \$1.00 [per bottle] on blockchain to track it."

And it is unclear who would be responsible for the added cost. "That is the \$64,000 question," Nowacki added. "Who is going to pay for that? Are we going to charge consumers an extra dollar for that bottle of fish oil tablets? Is CVS going to pay a dollar extra? Is the brand owner or manufacturer going to pay a dollar extra? It's a big problem and a reason that blockchain is currently being held back in the dietary supplement industry."

Another primary concern is interoperability of these systems — in other words, their ability to communicate with one another. Although it is still very early in the space, some blockchain systems already are being developed and used for supply chains in the food industry, including produce, seafood, tea, and dietary supplements. "The technology is in very early days, and we already have a Tower of Babel being built," Nowacki said. "Think about this being rolled out across thousands of ingredients. Suppliers along the way are saying 'Are you telling me I have to submit data to hundreds or thousands of separate proprietary supply chains?'" The longer-term solution is interoperability in which these platforms could talk to each other. "But no one has figured that out yet," he said.

Keeping information private and protecting intellectual property (IP) are also significant concerns. When Gupta started speaking with companies to develop the TagOne platform, he was asked a lot of questions about privacy and IP. The first thing to understand, he explained, is that there are both public and private blockchains. The kind of blockchain seen for Bitcoin is public. Everyone using it can access all the data. The TagOne blockchain is private, so only partners and the TagOne administrators have access to the data. Participating companies also do not have to share details like formulas or sales prices, Gupta noted. "You share ingredient lot numbers only as they move from one point to another. So you have to think only of that product movement and what needs to be tracked," Gupta said.

"If you are ordering a plant from someone, there is no IP involved in that," added Flaster. "When you start adding preparations, then yes, [IP] might be an issue, but that is not necessarily a part of the existing questions. This is just about quality issues."

The Devil Is in the Details

There is also a very common concern about protecting confidentiality of original suppliers to keep companies from skipping intermediary players in the supply chain. Nowacki noted common requests from companies who have asked if there was a way to remove or redact names of original suppliers to protect these sources.

Swaroop noted that one of the biggest obstacles Cepharm faced in implementing the TagOne blockchain system was a similar objection from sales and marketing. “When they learned that we were opening our books to farmers and gatherers, they were worried that we might lose orders,” said Swaroop. He dismissed these issues, believing that there are both challenges and opportunities to complete supply chain transparency. With transparency, he said, “buyers will trust us more, and that will drive loyalty and more orders. Some will go direct or go around us, but they will do that anyway, and this gives us the time and opportunity to weed out the bad suppliers and add good suppliers and create long-term relationships with them.” At the same time, he added, “we are getting complete data from farmers, intermediaries, processors, and suppliers in factories where there are huge issues.”

Greg Sommerville, founder of the Global Supplier Verification consultancy, is inclined to agree that the advantages of transparency outweigh the disadvantages. “I think if each supplier-customer relationship gives value, whatever it is, in whatever part of the supply chain they are in, whether they are on the ground in those countries or keeping certificates, this is not a problem. But you need to provide value to the customer; otherwise they will go around you,” he said (oral communication, March 14, 2019).

Nuherbs’ Lau suggests these issues can largely be solved in the design of a blockchain system. “Do the parties involved become anonymized? What information is part of the blockchain? Who has access to it? There are a lot of issues to consider, discuss, and finalize before it can be widely used. I think the first uses of blockchain will be simple tracking of information, maybe from the last two legs of the supply chain. Or between the brand and the retailer, and the blockchain will contain what the retailer needs to know from the brand,” he said.

Blockchain is an amazing tool that can change the world, said Gupta, but widespread adoption will take time. “We believe in blockchain and stand by it, but it is pretty far down the road. For many companies, they need to go from step one to step eight first,” he said.

Nowacki agrees that many important programs should come before incorporating blockchain into the supply chain, including compliance with regulatory requirements of the Dietary Supplement Health and Education Act of 1994 (DSHEA),²¹ the Food Safety Modernization Act²² (FSMA), and FSMA’s Preventive Controls Qualified Individual training programs, as well as the Foreign Supplier Verification Program.²³ “We deal with customers who don’t even have accurate lists of their suppliers and ingredients, who need basic data cleansing and data collection,” Nowacki said. “Once that’s done, there is the whole lengthy process of gathering all of the basic documents, whether it’s an organic certificate or a third-party audit. And then, once that’s done, there is the whole process mandate by FDA and the Food Safety Modernization Act, assessing all of your suppliers and all of those ingredients. We’ve got to build an entire house, and there are a thousand tasks that go into that. At the end of the process, maybe blockchain is the curtains in the window. But we’ve got to build the house first.”

Newmark, however, points out that blockchain does not have to be an all-or-nothing proposition. “Blockchain is a series of notes on a distributed ledger. It can be used as a one-to-one opportunity without implementing it in the rest of the supply chain. You don’t have to be on it or not. You could start the entire process with one farm on blockchain.”

Another key aspect of moving to the next level with blockchain is quantifying the return on investment (ROI). Swaroop acknowledges that at this point it is difficult to quantify the effect of the technology on Cepharm’s sales. “We opened the data in 2017, and at the time we are seeing more repeat orders, but not necessarily an uptick in sales,” he said.

A Level Playing Field

Swaroop believes the technology is helping to fight some longstanding business issues, such as competing against companies selling an ingredient for a price significantly lower than its market value. “I often can’t figure out how it is possible. We know the farmer and processor but we find another company selling at 20 percent lower than our price.”

This is where knowledge from blockchain could be valuable in providing checks and balances on the production and availability of a specific ingredient. If so much turmeric (*Curcuma longa*, Zingiberaceae) is being harvested, it should correspond with the amount of turmeric root available. If not, the question becomes “Where is it coming from?”

“Do the parties involved become anonymized? What information is part of the blockchain? Who has access to it? There are a lot of issues to consider, discuss, and finalize before it can be widely used.”

“I believe we can solve adulteration by using blockchain because if you can see the production of turmeric root is at 7,000 tons [for example] and there was 700 tons of turmeric available, we can check against that,” Swaroop said. “This will level the playing field and translate to a similar cost. So, unless you have some extreme technical innovation in a novel factory, for example, most ingredients products will be available for a similar price.”

This type of transparency may also promote greater trust and efficacy in the market, which is good business. “If I provide transparency, the customer will be more confident and happy to work with me than the guy next door who is playing the discounting game,” added Swaroop.

“Supplement customers are not always looking for the cheapest products but one they can trust,” Gupta said. “I am not saying that if you have a \$4 product you can sell it for \$40, but if you gain customer trust you might be able to sell it for \$8, and that makes good business sense.”

A little bit of upfront cost may be worthwhile, said Flaster, suggesting that knowledge of where ingredients come from can also help to reduce the risk of ingredient or product recalls and the cost of the resulting bad publicity.

Blockchain may also add value from a marketing and valuation standpoint because it effectively reduces risk and exposure. “There is a carrot and stick approach for ROI calculation,” said Trust Transparency Consulting’s Monheit. “Lower exposure is an added element that will become more and more important. Companies that have a transparency-based platform require less due diligence and therefore, in theory, can earn a higher valuation. So, a brand is worth more when it has less regulatory risk.”

Ultimately, once all these concerns and challenges about blockchain are addressed, the last question may be what the industry does when it has achieved widespread blockchain usage. The UK paper acknowledges that it is not yet possible to say whether blockchain systems will actually lead to more sustainable and equitable supply of high-quality botanicals, although it notes that botanical value chains provide a key opportunity to explore this potential.¹⁰ The report concludes that while blockchain may not prevent all the problems, it will increase traceability and make it easier to resolve problems.

Nowacki agrees that the technology has plenty to offer, but it does not account for human error or intentional fraud. “If you strip away all the issues, challenges, and costs, the core benefit is veracity of the data. Nobody can get in and commit fraud. That is a good thing and everybody wants that. Nobody wants a fraudulent ingredient upstream in the supply chain, so it is a good goal,” he said. “At the end

of the day, it is not just about the technology, but humans and the degree to which you can trust them at every step along the way.”

Trust and verification will always be a part of the mix in the herbal supply chain. “No technology, blockchain or otherwise, is going to be a perfect silver bullet against human fraudulence,” Nowacki said. “How do you trust but verify? Good brand owners rely on onsite audits, third-party audits, and laboratory testing for things like pesticides. So we have a system of checks and balances.”

Meanwhile, a few more companies may have to take a leap of faith to prompt broader usage. “We would like to see [blockchain] take a role in the herb industry, but haven’t had overtures from suppliers to my knowledge, and we are reliant on their leadership in terms of supply chain technology,” said Couch.

“Nuherbs won’t implement [blockchain] until there is a generally accepted standard, ease of implementation, and manageable cost of doing so.... The learning curve is steep, so will be the adaptation curve,” Lau said.

Nowacki believes it will take a consortium of technology leaders to come together and work on interoperability to lead to blockchain adoption, but that may take a while. “In my experience, when it comes to setting industry standards and revising technology, that happens not in months but in years,” he said. “I think we are a number of years away from these fundamental problems being solved, so this is not something to budget for in 2020.” HG

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Ultimately, once all these concerns and challenges about blockchain are addressed, the last question may be what the industry does when it has achieved widespread blockchain usage.

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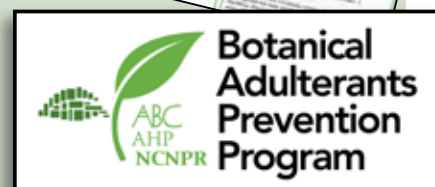
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Herbal Supplement Sales in US Increase by 9.4% in 2018

Record growth driven by sales of CBD, mushrooms, and immune-health products

By Tyler Smith,^a Michelle Gillespie,^b Veronica Eckl,^b Jake Knepper,^b and Claire Morton Reynolds^c

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Herbal supplement sales in the United States experienced record growth in 2018, increasing by an estimated 9.4% from 2017, according to the *Nutrition Business Journal* (NBJ). Consumers spent a total of \$8.842 billion on herbal supplements across all market channels in 2018 — an increase of roughly \$757 million in sales from the previous year. This marks the strongest US sales growth of herbal supplements since 1998.¹

The sales estimates in this report are based on US retail sales data provided by SPINS, a market research firm based in Chicago, Illinois, and NBJ, a Boulder, Colorado-based publication of the New Hope Network, an Informa media company that is focused on the natural products industry. NBJ provided estimates of total herbal supplement sales in the United States, as well as sales broken down by retail channel (mass market, natural and health food, and direct sales) and product type (single-herb supplements vs. combination formulas). SPINS provided sales data for the 40 top-selling herbal and fungal ingredients in both mainstream and natural retail channels. In previous years, SPINS collaborated with IRI, a market research firm also based in Chicago, to determine total mainstream sales for the 40 top-selling herbs. However, the database previously used by IRI was discontinued and, therefore, the mainstream sales figures in this report reflect data provided by SPINS only.

In addition to the strong overall sales growth for herbal dietary supplements in 2018, total retail sales increased in each of the three market channels monitored by NBJ in 2018. For the second year in a row, direct sales of herbal supplements experienced the strongest growth, increasing by 11.8% to a total of \$4.480 billion in 2018. NBJ's mass market channel experienced the second strongest growth in 2018, reaching a total of \$1.558 billion, an increase of 7.6% from the previous year. Finally, herbal supplement sales in natural and health food stores totaled \$2.804 billion in 2018, according to NBJ, an increase of 6.9% from 2017.

The SPINS sales data for individual herbs and fungi discussed in this report reflect sales of dietary supplements in which that herb or fungus is the primary functional ingredient. This includes only products that meet the legal definition of a dietary supplement per the US Food and Drug Administration (FDA).¹ The figures in this report reflect the



Horehound *Marrubium vulgare*
Photo ©2019 Steven Foster

most current estimates (as of July 2019) for herbal dietary supplement sales during the 52-week period ending December 30, 2018. Sales figures are for dietary supplement products only and do not reflect sales of herbal teas or cosmetics with botanical ingredients.

Supplements for Immune Health and Weight Management Drive Mainstream Retail Sales

Among the top-selling herbal dietary supplements in mainstream US retail outlets, products with horehound (*Marrubium vulgare*, Lamiaceae) listed as the primary ingredient have grossed the highest sales each year since 2013, and this remained true in 2018. Sales of horehound supplements totaled \$146,624,255 in 2018, a 4.1% increase in sales from 2017. Horehound, a member of the mint family, has bitter properties and has been used traditionally for respiratory issues, such as cough and colds, and, less commonly, for digestive conditions, such as stomachache and intestinal worms.² As a dietary supplement, horehound is now most commonly found in cough drop and lozenge preparations.

Goji (*Lycium* spp., Solanaceae) berry supplements experienced the strongest growth in the 2018 mainstream channel, with sales increasing 637% from 2017. Sales of goji

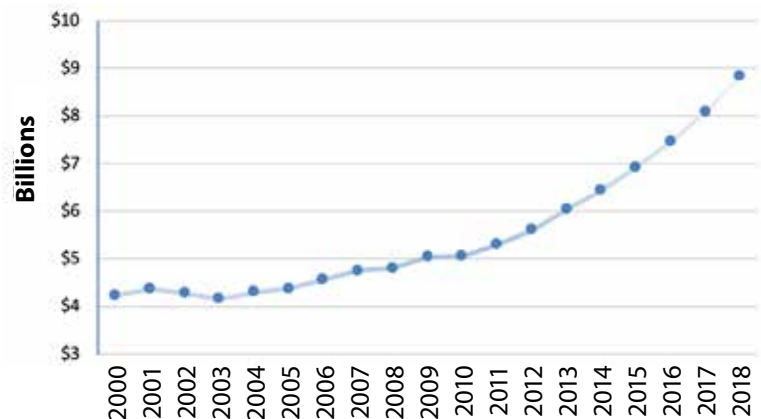
Table 1. Total US Retail Sales of Herbal Supplements*

Year	Total Sales	% Change
2018	\$8.842 billion	9.4%
2017	\$8.085 billion	8.5%
2016	\$7.452 billion	7.7%
2015	\$6.922 billion	7.5%
2014	\$6.441 billion	6.8%
2013	\$6.033 billion	7.9%
2012	\$5.593 billion	5.5%
2011	\$5.302 billion	4.5%
2010	\$5.049 billion	3.3%
2009	\$5.037 billion	5.0%
2008	\$4.800 billion	1.0%
2007	\$4.756 billion	4.4%
2006	\$4.558 billion	4.1%
2005	\$4.378 billion	2.1%
2004	\$4.288 billion	3.4%
2003	\$4.146 billion	-2.3%
2002	\$4.275 billion	-2.8%
2001	\$4.361 billion	3.2%
2000	\$4.225 billion	2.9%

Source: *Nutrition Business Journal*

* Includes sales in all channels. NBJ primary research includes NBJ surveys of supplement manufacturers, distributors, multilevel marketing firms, mail order, internet, and raw material and ingredient supply companies, as well as interviews with major retailers (Walmart, Costco, etc.), manufacturers, suppliers, and industry experts. Secondary sources include IRI, SPINScan Natural, Nielsen, *Natural Foods Merchandiser*, Insight, The Hartman Group, company data, and other published material.

Figure 1. Total US Retail Sales of Herbal Supplements (2000-2018)



Source: *Nutrition Business Journal*



Turmeric *Curcuma longa*
Photo ©2019 Steven Foster

	SPINS	Nutrition Business Journal
Mainstream Channels	<p>Mainstream Multi-Outlet Channel This channel coverage includes the food, drug, and mass market sector (or "FDM"; supermarkets, drugstores, and mass market retailers), military commissaries, select buyer's clubs, and so-called "dollar stores." SPINS data do not include convenience store sales.</p>	<p>Mass Market Channel Mass market includes food/grocery, drug, mass merchandise, and club and convenience stores, including Walmart, Costco, etc.</p>
Natural Channels	<p>Natural Channel Includes co-ops, associations, independent retailers, and large regional chains. These data do not include sales from Whole Foods Market, which does not report its dietary supplement sales to SPINS or other market tracking firms. Only full-format stores with at least \$2 million in annual sales (with at least 50% of sales from natural/organic products) are included.</p>	<p>Natural & Health Food Channel Natural and health food include supplement and specialty retail outlets, including Whole Foods Market (estimates), GNC, sports nutrition stores, etc.</p>
Direct Sales Channel		<p>Direct sales include internet, mail order (including catalogs), direct mail, and direct response TV and radio; practitioners representing conventional and alternative products selling to their patients, including ethnic and herbal shops; and multilevel marketing and network marketing firms.</p>
<p>* The sales discussed in this article pertain only to those involving herbal and other plant-based dietary supplements, and generally do not include herbs sold as teas and beverages or as ingredients in personal care and cosmetic products, including so-called "cosmeceutical" products.</p>		



Elderberry *Sambucus nigra*
Photo ©2019 Steven Foster

berry totaled \$10,401,244 in 2018, making it 26th top-selling supplement ingredient in this channel. Goji berry first appeared among the top 40 herbal supplements in the mainstream channel in 2015 during the so-called “superfood” craze. Mainstream sales of the ingredient declined in 2016 and 2017 as the market became saturated with a variety of “new” superfoods, but goji berry experienced a resurgence in popularity in 2018.

According to SPINS, the top-selling goji berry products in the 2018 mainstream channel were marketed for weight loss. Twenty percent of all supplement users in the United States purchased products marketed for weight loss in 2018, according to the Council for Responsible Nutrition’s (CRN’s) 2018 Consumer Survey on Dietary Supplements. However, only supplement users in the 18- to 34-year-old age group listed weight loss as one of the six primary reasons for taking supplements.³ As noted in previous *HerbalGram* market reports, consumers are increasingly choosing products for weight management, as opposed to weight loss, with the goal of improving health in general. Overall health and wellness remained the top health reason for consumers to take supple-

ments across all age groups in 2018, CRN’s report noted.³

Besides goji berry, three other ingredients on the top 40 list had mainstream sales increases greater than 40% in 2018 (based on dollar volume): ashwagandha (*Withania somnifera*, Solanaceae), elderberry (*Sambucus nigra*, Adoxaceae), and barberry (*Berberis* spp., Berberidaceae).

For the first time, strong sales of ashwagandha supplements in mainstream retail outlets earned the herb a spot among the 40 top-selling ingredients in this channel. Mainstream ashwagandha sales in 2018 increased 165.9% from the previous year, with sales totaling \$7,449,103. Ashwagandha has been one of the 40 top-selling ingredients in natural retail stores since 2015, but its appearance among the top 40 herbs in the mainstream channel in

Table 3. Total US Herbal Supplement Sales by Channel

	2014	2015	2016	2017	2018	% Change from 2017
Mass Market	\$1.116 billion	\$1.204 billion	\$1.336 billion	\$1.449 billion	\$1.558 billion	7.6%
Natural & Health Food	\$2.186 billion	\$2.356 billion	\$2.506 billion	\$2.624 billion	\$2.804 billion	6.9%
Direct Sales	\$3.139 billion	\$3.363 billion	\$3.609 billion	\$4.012 billion	\$4.480 billion	11.8%

Source: *Nutrition Business Journal*

Table 4. Top-Selling Herbal Supplements in 2018 — US Mainstream Multi-Outlet Channel

Rank	Primary Ingredient	Latin Binomial	Total Sales	% Change from 2017
1	Horehound	<i>Marrubium vulgare</i>	\$146,624,255	4.1%
2	Echinacea ^a	<i>Echinacea</i> spp.	\$110,331,569	15.1%
3	Turmeric ^b	<i>Curcuma longa</i>	\$93,312,677	30.5%
4	Elderberry	<i>Sambucus nigra</i>	\$50,979,669	138.4%
5	Green tea	<i>Camellia sinensis</i>	\$45,160,552	14.2%
6	Ginger	<i>Zingiber officinale</i>	\$38,714,413	2.0%
7	Ivy leaf	<i>Hedera helix</i>	\$37,838,209	10.8%
8	Garlic	<i>Allium sativum</i>	\$37,723,155	-0.1%
9	Fenugreek	<i>Trigonella foenum-graecum</i>	\$32,498,548	9.2%
10	Black cohosh	<i>Actaea racemosa</i>	\$31,673,127	-6.0%
11	Saw palmetto	<i>Serenoa repens</i>	\$26,973,790	-0.4%
12	Flax seed / Flax oil	<i>Linum usitatissimum</i>	\$26,166,486	-8.2%
13	Yohimbe	<i>Pausinystalia johimbe</i>	\$23,237,235	0.5%
14	Pumpkin	<i>Cucurbita pepo</i>	\$22,564,912	19.5%
15	Garcinia	<i>Garcinia gummi-gutta</i>	\$22,485,106	-40.6%
16	Aloe vera	<i>Aloe vera</i>	\$21,884,788	2.9%
17	Wheatgrass / Barley grass	<i>Triticum aestivum</i> / <i>Hordeum vulgare</i>	\$21,011,606	-18.4%
18	Cinnamon	<i>Cinnamomum</i> spp.	\$17,729,373	-9.2%
19	Valerian	<i>Valeriana officinalis</i>	\$17,054,774	-6.6%
20	Milk thistle	<i>Silybum marianum</i>	\$16,596,226	-1.6%
21	Green coffee extract	<i>Coffea arabica</i>	\$16,296,449	30.3%
22	Ginkgo	<i>Ginkgo biloba</i>	\$16,041,038	-9.1%
23	Ginseng	<i>Panax</i> spp.	\$12,791,025	19.3%
24	Senna ^c	<i>Senna alexandrina</i>	\$11,804,678	-14.4%
25	Horny goat weed	<i>Epimedium</i> spp.	\$11,208,713	18.4%
26	Goji berry	<i>Lycium</i> spp.	\$10,401,244	637.0%
27	Rhodiola	<i>Rhodiola</i> spp.	\$9,674,434	-11.4%
28	Boswellia	<i>Boswellia serrata</i>	\$9,634,442	-34.2%
29	Guarana	<i>Paullinia cupana</i>	\$8,364,799	-8.1%
30	Beet root	<i>Beta vulgaris</i>	\$8,292,604	33.5%
31	Fennel	<i>Foeniculum vulgare</i>	\$8,166,627	-12.9%
32	Açaí	<i>Euterpe oleracea</i>	\$7,890,516	-7.9%
33	Maca	<i>Lepidium meyenii</i>	\$7,718,876	15.7%
34	Ashwagandha	<i>Withania somnifera</i>	\$7,449,103	165.9%
35	Evening primrose oil	<i>Oenothera biennis</i>	\$6,500,843	-4.0%
36	St. John's wort	<i>Hypericum perforatum</i>	\$5,767,644	-2.6%
37	Barberry	<i>Berberis</i> spp.	\$5,060,098	47.3%
38	Yerba maté	<i>Ilex paraguariensis</i>	\$4,442,408	-33.3%
39	Horsetail	<i>Equisetum</i> spp.	\$4,233,015	5.1%
40	Borage oil	<i>Borago officinalis</i>	\$3,537,347	33.8%

Source: SPINS (52 weeks ending December 30, 2018)

^a Includes three *Echinacea* species: *E. angustifolia*, *E. pallida*, and *E. purpurea*.

^b Includes standardized turmeric extracts with high levels of curcumin.

^c Excludes over-the-counter laxative drugs containing senna or sennosides.

2018 suggests more widespread familiarity among casual consumers of natural products. Mainstream ashwagandha sales in 2018 likely benefitted from the continued popularity of ingredients traditionally used in Ayurveda, the primary traditional medical system of India. Turmeric (*Curcuma longa*, Zingiberaceae), another popular Ayurvedic ingredient, which experienced the largest mainstream sales increase in 2017, had a 30.5% increase in sales from 2017 and ranked third in 2018.

Elderberry sales also saw strong growth in 2018, increasing by 138.4% from 2017 to a total of \$50,979,669, making it the fourth top-selling ingredient in this channel. Rising sales of elderberry, which is commonly found in products marketed for immune health, may have been related to the unusually severe flu activity reported for the 2017-2018 season in the United States. According to the US Centers for Disease Control and Prevention, the 2017-2018 season was one of the longest flu seasons in recent years and the first to be ranked as “high severity” in all age groups.⁴ Several ingredients typically sold for immune health benefits performed well across both market channels in 2018. In the mainstream channel, echinacea (*Echinacea* spp., Asteraceae) and ivy leaf (*Hedera helix*, Araliaceae), for example, saw increases of 15.1% and 10.8%, respectively.

Barberry, another ingredient new to the mainstream top 40 list in 2018, saw the only other increase greater than 40% among the top 40 ingredients in 2018 (by dollar volume). Sales of barberry increased by 47.3% from 2017, totaling \$5,060,098. According to SPINS, many of the top-selling barberry supplements were marketed for their berberine content and liver support benefits. Berberine is an alkaloid found in several plants, including goldenseal (*Hydrastis canadensis*, Ranunculaceae) and Oregon grape (*Berberis aquifolium*, Berberidaceae), among others. In vitro studies have found that berberine exhibits anti-inflammatory and antioxidant activities, and results from human clinical trials suggest that it may be useful for lowering blood lipids and blood glucose and improving insulin resistance.⁵ In addition, a recent meta-analysis of six randomized clinical trials concluded that berberine



Tea *Camellia sinensis*
Photo ©2019 Steven Foster



Ginger *Zingiber officinale*
Photo ©2019 Steven Foster



Ivy leaf *Hedera helix*
Photo ©2019 Steven Foster

Table 5. Top-Selling Herbal Supplements in 2018 — US Natural Channel

Rank	Primary Ingredient	Latin Binomial	Total Sales	% Change from 2017
1	Cannabidiol (CBD)	<i>Cannabis</i> spp.	\$52,708,488	332.8%
2	Turmeric ^a	<i>Curcuma longa</i>	\$51,213,502	0.4%
3	Elderberry	<i>Sambucus nigra</i>	\$25,374,666	93.9%
4	Wheatgrass / Barley grass	<i>Triticum aestivum</i> / <i>Hordeum vulgare</i>	\$19,484,470	-3.3%
5	Flax seed / Flax oil	<i>Linum usitatissimum</i>	\$13,903,851	-7.5%
6	Aloe vera	<i>Aloe vera</i>	\$13,788,574	-1.0%
7	Ashwagandha	<i>Withania somnifera</i>	\$12,426,468	16.9%
8	Milk thistle	<i>Silybum marianum</i>	\$10,419,926	3.5%
9	Echinacea ^b	<i>Echinacea</i> spp.	\$9,979,769	11.0%
10	Oregano ^c	<i>Origanum vulgare</i>	\$9,925,727	9.9%
11	Psyllium	<i>Plantago</i> spp.	\$8,348,322	6.2%
12	Maca	<i>Lepidium meyenii</i>	\$8,246,315	-9.8%
13	Mushrooms (other)	—	\$7,800,366	40.9%
14	Saw palmetto	<i>Serenoa repens</i>	\$7,702,838	-2.1%
15	Cranberry	<i>Vaccinium macrocarpon</i>	\$7,454,158	6.2%
16	Garlic	<i>Allium sativum</i>	\$6,894,668	2.7%
17	Valerian	<i>Valeriana officinalis</i>	\$6,706,263	4.8%
18	Echinacea-Goldenseal combo	<i>Echinacea</i> spp. / <i>Hydrastis canadensis</i>	\$6,271,607	8.7%
19	Nigella	<i>Nigella sativa</i>	\$5,839,472	21.1%
20	Horsetail	<i>Equisetum</i> spp.	\$5,406,810	2.0%
21	Ginkgo	<i>Ginkgo biloba</i>	\$4,632,234	-0.3%
22	Hemp products	<i>Cannabis</i> spp.	\$4,172,735	-9.9%
23	Cherry fruit	<i>Prunus</i> spp.	\$3,638,295	0.2%
24	Kava	<i>Piper methysticum</i>	\$3,626,397	2.9%
25	Fenugreek	<i>Trigonella foenum-graecum</i>	\$3,546,222	-6.9%
26	Ginger	<i>Zingiber officinale</i>	\$3,453,791	15.9%
27	Holy basil	<i>Ocimum tenuiflorum</i>	\$3,421,090	-3.0%
28	Ginseng	<i>Panax</i> spp.	\$3,339,628	2.8%
29	Olive leaf	<i>Olea europaea</i>	\$3,269,066	0.5%
30	Papaya	<i>Carica papaya</i>	\$3,214,680	5.5%
31	Evening primrose oil	<i>Oenothera biennis</i>	\$3,125,425	-0.5%
32	Reishi	<i>Ganoderma lucidum</i>	\$3,115,943	29.4%
33	Beet root	<i>Beta vulgaris</i>	\$2,988,528	23.6%
34	Stevia	<i>Stevia rebaudiana</i>	\$2,974,413	18.6%
35	Black cohosh	<i>Actaea racemosa</i>	\$2,828,784	-7.3%
36	Moringa	<i>Moringa oleifera</i>	\$2,810,023	2.5%
37	Hawthorn	<i>Crataegus</i> spp.	\$2,801,274	5.5%
38	Rhodiola	<i>Rhodiola</i> spp.	\$2,721,759	1.6%
39	Kelp	<i>Laminaria digitata</i>	\$2,684,103	-3.7%
40	Garcinia	<i>Garcinia gummi-gutta</i>	\$2,638,311	-49.8%

Source: SPINS (52 weeks ending December 30, 2018)

^a Includes standardized turmeric extracts with high levels of curcumin.

^b Includes three *Echinacea* species: *E. angustifolia*, *E. pallida*, and *E. purpurea*.

^c Includes products labeled as containing oregano oil and oregano leaf tinctures.

may have positive effects on liver function and for nonalcoholic fatty liver disease, but the authors recommended additional, higher-quality studies to confirm these potential benefits.⁶

The only ingredient on the top 40 list that experienced a decrease in mainstream sales of more than 40% in 2018 was garcinia (*Garcinia gummi-gutta*, Clusiaceae). Sales of garcinia fruit preparations totaled \$22,485,106 in 2018, a 40.6% decrease from 2017. Despite falling sales, garcinia supplements still ranked 15th in overall sales in the mainstream channel. Although sales of other herbal ingredients typically marketed for weight loss tended to perform well in 2018, garcinia's claimed weight-loss benefits may have been overshadowed by negative media coverage. In July 2018, for example, popular daytime talk show host Dr. Mehmet Oz settled a case for \$5.25 million in which plaintiffs alleged that he promoted garcinia as a "magic weight-loss cure" with no supporting scientific evidence.⁷

As *HerbalGram's* annual market reports generally focus on specific herbs and fungi, certain ingredients are excluded from the top 40 list each year. Three products that would have appeared on the 40 top-selling ingredients list in the US mainstream channel were removed: "bee products (not propolis)," "Ayurvedic herbs (other)," and Relora® (InterHealth Nutraceuticals/Lonza; Benicia, California). Although bee products (e.g., pollen, royal jelly, etc.) are considered natural products, *HerbalGram* chose not to include this category of ingredients as they are neither herbs nor fungi. If non-propolis bee products had remained on the list, they would have ranked 13th in overall sales. Ayurvedic herbs (other) also was excluded due to its lack of specificity. Had it remained on the list, it would have ranked 37th in total mainstream sales in 2018, after excluding non-propolis bee products. Finally, as the only branded supplement on the list, Relora, a combination formula containing bark extracts of magnolia (*Magnolia offic-*

Table 6. Total US Retail Sales of Herbal Supplements by Type (Single vs. Combo)

	Total Sales	% of Total Sales	% Growth
2018			
Single Herbs	\$5.083 billion	57.5%	6.8%
Combination Herbs	\$3.759 billion	42.5%	13.1%
2017			
Single Herbs	\$4.759 billion	58.9%	5.6%
Combination Herbs	\$3.326 billion	41.1%	12.9%
2016			
Single Herbs	\$4.505 billion	60.5%	6.1%
Combination Herbs	\$2.947 billion	39.5%	10.1%
2015			
Single Herbs	\$4.245 billion	61.3%	5.5%
Combination Herbs	\$2.677 billion	38.7%	10.7%
2014			
Single Herbs	\$4.024 billion	62.5%	6.2%
Combination Herbs	\$2.418 billion	37.5%	7.7%
Source: <i>Nutrition Business Journal</i>			



Garlic *Allium sativum*
Photo ©2019 Steven Foster



Flax *Linum usitatissimum*
Photo ©2019 Steven Foster



Fenugreek *Trigonella foenum-graecum*
Photo ©2019 Steven Foster



Black cohosh *Actaea racemosa*
Photo ©2019 Steven Foster

alis, Magnoliaceae) and phellodendron (*Phellodendron amurense*, Rutaceae), also was removed from the report. Had it been included, Relora would have ranked 39th in total overall mainstream sales, after excluding non-propolis bee products and Ayurvedic herbs (other).

CBD and Mushroom Supplements Experience Significant Growth in Natural Retail Channel

Since 2013, turmeric has been the top-selling herbal dietary supplement ingredient in natural retail stores in the United States. But, in 2018, skyrocketing sales of cannabidiol (CBD), a psychoactive but nonintoxicating constituent of *Cannabis sativa* (Cannabaceae), made it not only the top-selling ingredient in the natural channel but also the fastest-growing. SPINS has been tracking sales of CBD since 2016, but it made its first appearance on the natural channel's top 40 list in 2017 as the 12th top-selling ingredient, with a 303% increase in sales from the previous year. In 2018, CBD sales totaled \$52,708,488 — a 332.8% increase from 2017.

According to SPINS, roughly 60% of the CBD products sold in the US natural channel in 2018 were in the form of alcohol-free tinctures, followed by capsules and softgels. The vast majority of the CBD products were marketed for “non-specific health focuses,” with mood support and sleep as the next most-popular uses.

Although CBD products have been sold online and in stores for years, the federal regulatory situation remains complicated. SPINS explained that the CBD supplements included in the natural channel data are products that contain CBD extracted from the aerial parts of hemp — an important legal distinction. Upon the passage of the 2018 Farm Bill, the FDA removed hemp (defined as any *Cannabis sativa* plant “with a delta-9 tetrahydrocannabinol [THC] concentration of not more than 0.3 percent on a dry weight basis”) from the Controlled Substances Act (CSA). However, any *Cannabis sativa* plants (or parts/derivates thereof) with a THC concentration above 0.3% (defined as “cannabis” or “marihuana”) remain Schedule I substances under the CSA.⁸

Still, as of July 2019, the FDA does not consider CBD, regardless of its origin, to be a legal dietary supplement ingredient under section 201(ff)(3)(B) of the Federal Food, Drug, and Cosmetic (FD&C) Act, according to its website.⁸ The FDA has noted that “if a substance (such as ... CBD) is an active ingredient in a drug product that has been approved under section 505 of the FD&C Act [21 U.S.C. § 355], ... then products containing that substance are excluded from the definition of a dietary supplement.” In a Q&A on its website, the FDA explains that CBD is the main active ingredient in Epidiolex® (GW Pharmaceuticals; Salisbury, UK), which the FDA approved in June 2018.⁹ Despite this, CBD products have flooded the US marketplace, and sales show no signs of slowing.

Although sales of CBD products increased significantly in 2018, sales of hemp products declined by 9.9%. According to SPINS, the majority of supplements in this category are hemp seed oils that contain a negligible amount of CBD and typically are marketed for their omega-3 fatty acid content. The reason for the sales decline is unclear, but it may be due to increased availability of and consumer preference for other plant-based sources of protein and fiber.

The only other ingredients in the natural channel with sales increases greater than 40% in 2018 were elderberry (93.9%), discussed previously, and “mushrooms (other).” SPINS tracks sales of a few individual species of fungi, including reishi (*Ganoderma lucidum*, Ganodermataceae), chaga (*Inonotus obliquus*, Hymenochaetaceae), and cordyceps (*Cordyceps militaris*, Cordycipitaceae), while the mushrooms (other) category combines sales of multiple species, including lion’s mane (*Hericium erinaceus*, Hericiaceae), turkey tail (*Trametes versicolor*, Polyporaceae), and blends thereof. Sales of mushrooms (other) increased by 40.9% from 2017 and totaled \$7,800,366 in 2018. After CBD, elderberry, and mushrooms (other), reishi had the fourth highest percent sales increase in 2018 in the natural chan-

nel among the top 40 ingredients, with a 29.4% increase from the previous year.

According to SPINS, mushrooms (other) were primarily sold in the form of vegetable capsules and powders. Many of the top mushroom products in this category listed immunity or cognitive health as main health focuses, followed by non-specific uses. Sales of mushroom products marketed for immune health may have increased in part due to the extended 2017-2018 flu season.

In its annual food trends forecast, Whole Foods Market correctly predicted that functional mushrooms would be a top-seller during 2018.¹⁰ Similarly, in its “Top 10 Trends Predictions for 2018,” SPINS projected that adaptogens would see increased growth in 2018 and that there would

Lion's mane *Hericium erinaceus*
Photo ©2019 Lebrac





Milk thistle *Silybum marianum*
Photo ©2019 Steven Foster

be “continued (and progressively innovative) applications of functional mushrooms across food, beverages, and dietary supplements, plus the integration of other ingredients that focus on adaptogenic properties.”¹¹ In general terms, an adaptogen is a substance that improves the body’s ability to adapt to stress, although various definitions exist.¹² In 2018, functional mushrooms with claimed adaptogenic properties increasingly were incorporated into a range of products, including chocolates, coffee, and cosmetics.¹³

As in the mainstream channel, the only top 40 ingredient that experienced a sales decrease of more than 40% in the natural channel was garcinia. Sales of garcinia supplements in natural retail outlets decreased by 49.8% from 2017 to

2018, during which time it dropped from the 20th top-selling ingredient to the 40th top-selling ingredient.

HerbalGram chose to exclude three ingredients originally in the top 40 list in the natural channel: spirulina (*Arthrospira platensis* and *A. maxima*, Microcoleaceae) and chlorella (*Chlorella vulgaris*, Chlorellaceae), which are classified as cyanobacteria and algae, respectively, and arginine, an amino acid. Had it remained on the list, spirulina would have ranked 11th in total overall sales in the 2018 natural channel. Chlorella would have ranked 20th (after excluding spirulina), and arginine would have ranked 31st (after excluding spirulina and chlorella).

Direct Sales

For the second year in a row, percent sales growth of herbal supplements in the direct sales channel was higher than the percent sales growth in the mass market and natural and health food channels, according to NBJ’s estimates. Sales in this market channel grew by 11.8% from 2017 and totaled \$4.480 billion in 2018. The direct sales channel includes multi-level marketing companies (also known as network marketing companies), mail- and internet-order sales companies, direct-response TV and radio sales, and sales by health practitioners.

Single-Herb Supplements vs. Combination Formulas

Since 2011, sales of combination formulas (multi-herb supplements) have grown faster, by percentage, than that of single-herb supplements. This was the case once again in 2018, with sales of combination formulas and single-herb supplements increasing by 13.1% and 6.8%, respectively. Combination formulas typically include multiple herbs designed to work

additively and/or synergistically to support a particular health function (or functions), while single-herb supplements often are intended for a variety of uses. Although single-herb supplements have composed the majority of total sales for more than a decade, the percentage gap between overall sales of these two product types has been closing each year.

Conclusion

Total sales of herbal supplements in the United States have increased each year since 2004, with sales of these products more than doubling during this period. In-

ingly, US consumers are gravitating toward plant-based products that they perceive as safe, natural, and effective options to help maintain health and wellness. Perhaps not surprisingly, herbal supplements experienced stronger percent sales growth than the dietary supplements category as a whole in 2018.¹⁴ Previously trending ingredients, such as Ayurvedic herbs and botanicals with general health benefits, continued to be top-sellers in both mainstream and natural channels in 2018, while several ingredients with newfound, widespread popularity, such as mushrooms and CBD, also fueled sales, particularly in natural retail outlets. Given that 2018 experienced the strongest overall sales growth in two decades, and the natural products industry's ongoing focus on increased transparency and self-regulation efforts, consumer trust in herb- and fungi-based products appears to remain strong. HG

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Elderberry *Sambucus nigra*
Photo ©2019 Steven Foster

The Food Explorer: The True Adventures of the Globe-Trotting Botanist Who Transformed What America Eats by Daniel Stone. New York, NY: Dutton Books; 2019. ISBN: 9781101990599. Softcover, 416 pages. \$17.00.

By Hannah Bauman

In the late 19th century, the ability of a young man from rural Kansas to travel the globe was limited. However, due to his willingness to explore (taking a Smithsonian grant to study algae cells in Naples, Italy) and some unlikely opportunities (an invitation to travel the world with an eccentric millionaire), botanist David Fairchild did just that, and ended up playing a key role in shaping the diverse food system of the United States.

Daniel Stone's biography of Fairchild also discusses the history of agriculture in the United States from the end of the American Revolutionary War in 1783 to Fairchild's death in 1954. All told, Fairchild introduced more than 200,000 plants to the United States, engaging in methods that often verged into espionage and smuggling, on behalf of the US Department of Agriculture (USDA). The variety of plants he brought from all over the world include popular food crops; new strains of economically important commercial crops such as cotton (*Gossypium hirsutum*, Malvaceae) and rice (*Oryza sativa*, Poaceae); and decorative trees and flowers, including the Japanese cherry (*Prunus* spp., Rosaceae) trees that still adorn Washington, DC.

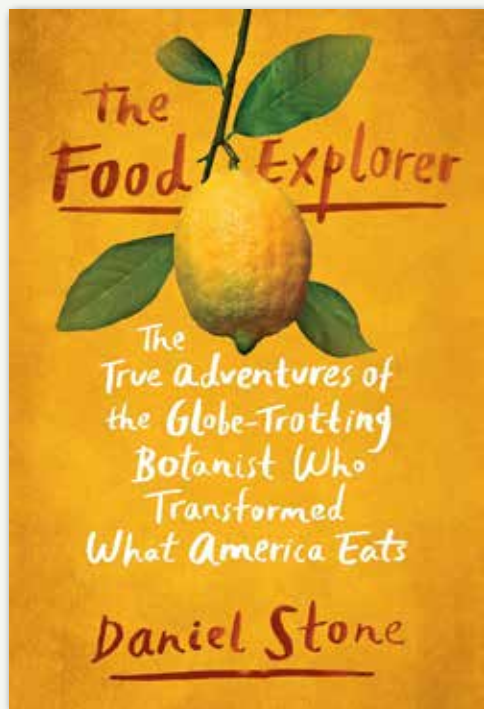
During Fairchild's youth, the US agricultural system composed a large sector of the economy, but it lacked variety. As such, "American cuisine" did not exist, and the vari-

ous immigrant groups that populated the country stuck to the staples of their native cultures, with little intermixing. However, the USDA had plans to create a more diverse array of food crops, and Fairchild, who began working at the department after earning his master's degree in botany from Kansas State College of Agriculture, agreed to go on plant-collecting expeditions as a way to travel the world — a rare opportunity for an American before the "Gilded Age."

Readers may recognize many of the historical figures who passed through Fairchild's life: Marian Bell, Fairchild's wife and the daughter of Alexander Graham Bell; William McKinley, who served as president of the United States while Fairchild was at the USDA, where Fairchild established and managed the Office of Seed and Plant Introduction; and Frank Nicholas Meyer, a food explorer like Fairchild in whose honor the Meyer lemon (*Citrus × meyeri*, Rutaceae) is named. These stories help provide context for Fairchild's own, which could at times seem outlandish with his globe-trotting, tropical illnesses, arrests, and other mishaps.

Readers with an interest in botanical history, or, for example, how kale (*Brassica oleracea*, Brassicaceae) from Croatia became a staple in the US "superfood" movement, may be interested in the story of Fairchild's life. Stone, a journalist who writes for *National Geographic* and *Newsweek*, among other outlets, approaches the subject of the US agricultural sector

with a deft hand, lightening what could otherwise be a dry and dense topic by allowing the reader to view the discovery of avocados (*Persea americana*, Lauraceae), dates (*Phoenix dactylifera*, Arecaceae), cashews (*Anacardium occidentale*, Anacardiaceae), and other plants through Fairchild's own sense of wonder. HG



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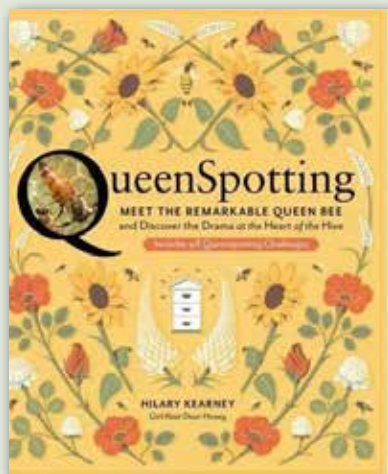
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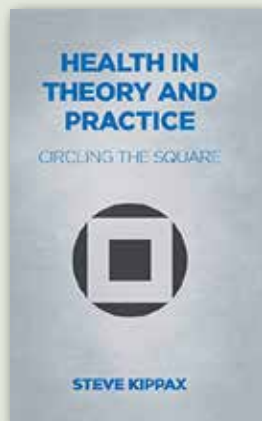
Health in Theory and Practice: Circling the Square by Steve Kippax. London, UK: Aeon Books; 2019. Softcover, 408 pages. ISBN: 9781911597650. \$20.99.

Health in Theory and Practice views 21st-century health care through a holistic lens and focuses on total wellness. Each chapter reviews facets of health maintenance and recovery, including diet, exercise, mindfulness, and herbal medicine. Due to the author's specialization in traditional Chinese medicine (TCM), the chapters emphasize aspects of this healing approach. The chapter on herbal medicine contains an overview and focus on energetic traditions, including TCM and Ayurveda; however, the *materia medica* provides information on popular Chinese, Ayurvedic, and Western herbs.

QueenSpotting: Meet the Remarkable Queen Bee and Discover the Drama at the Heart of the Hive by Hilary Kearney. North Adams, MA: Storey Publishing; 2019. Hardcover, 128 pages. ISBN: 9781635860375. \$19.95.

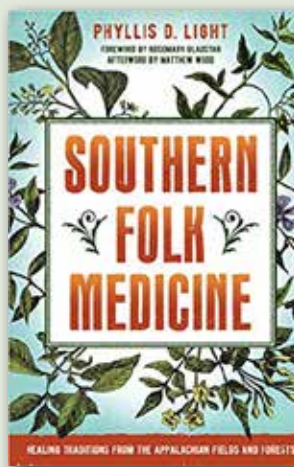


Integral to the health of flowering medicinal plants, a healthy bee colony is anchored by its queen. Urban beekeeper Hilary Kearney has created a guide that will appeal to new and experienced apiarists and celebrates the unique lifecycle



of the queen bee. The photo-heavy book includes “queenspotting” puzzles at the beginning of each chapter: enlarged, fold-out panoramic photos of the queen among hordes of drones, which increase in difficulty as the book progresses.

Southern Folk Medicine: Healing Traditions from the Appalachian Fields and Forests by Phyllis D. Light. Berkeley, CA: North Atlantic Books; 2018. Softcover, 304 pages. ISBN: 9781623171568. \$21.95.

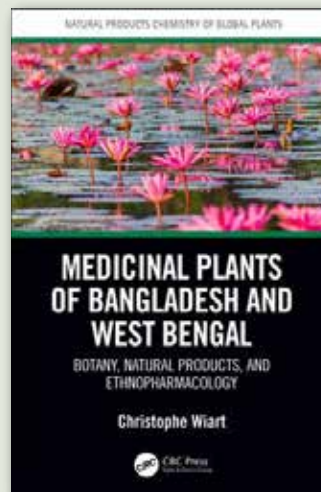


This book describes in great detail the history, folklore, practices, and traditional remedies of Southern and Appalachian folk medicine. Heavily based on ancient Greek and European practices and melded with Native American, Christian, and African influences, these systems offer a uniquely American way to look at disease and wellness. Herbal practitioner Phyllis Light has worked with Southern folk medi-

cine for more than 30 years, and she relates to readers the traditions passed down through the generations by healers who cared for their communities with the plants and resources that surrounded them.

Medicinal Plants of Bangladesh and West Bengal: Botany, Natural Products, and Ethnopharmacology by Christophe Wiart. Boca Raton, FL: CRC Press; 2019. Hardcover, 278 pages. ISBN: 9781315186443. \$149.95.

This text from Asian ethnopharmacology expert Christophe Wiart, PharmD, PhD, provides background and identification information, including chemical constituents, pharmacological activity, and toxicology, of more than 100 medicinal species used in Bangladesh and surrounding areas. Arranged alphabetically by botanical family, the highlighted herbs will be useful for researchers and students interested in the study of the potential pharmacological applications of these natural products. Each entry features field photos and ethnopharmacological uses, as well as a monograph. The information is geared toward various disciplines, including pharmacy, pharmacology, medicine, biotechnology, nutrition, cosmetology, and conventional drug development.



Alan Richman

1939–2019

By Hannah Bauman

Former *WholeFoods Magazine* Editor-in-Chief Alan Richman died on March 13, 2019, at age 79. Richman's long career in journalism included 13 years at the natural products trade magazine, which is one of the longest continuously published media outlets in the industry. Colleagues recall Richman's kind and generous nature and his willingness to share his wisdom and experience to produce high-quality work.

"Alan was a special friend and made many contributions to our company and the industry," wrote Howard Wainer, president of *WholeFoods* (email, May 16, 2019). "He had worked with me for several years [previously].... Once I started my own publication, he eventually joined *WholeFoods* as our fourth editor-in-chief."

Heather Wainer, publisher of *WholeFoods*, also remembered Richman's geniality. "Alan was not only a great writer and editor but an excellent teacher," she wrote (email, June 6, 2019). "He worked tirelessly to put out the best editorial [work] and at a trade show he made sure he spoke to all. He was very well respected by all he worked with.... He always had a story for you and loved life and everyone in his life."

Richman was born in the Bronx, New York City, on November 12, 1939. He started his journalism career at Hunter College, part of the City University of New York, and was the editor of the school's student newspaper, *The Arrow*. He graduated from Hunter College in 1960 with a bachelor's degree in English and served in the US Army from 1961 to 1962. While stationed at Fort Bragg in North Carolina, Richman continued to pursue his interest in journalism and served as the editor of the post's newspaper.

Upon completing his service in the Army, Richman returned to New York and married Kelli Shor in 1964. He worked as a reporter and editor for multiple publications around the city, especially trade publications, and his work earned him a prestigious Jesse H. Neal Certificate of Merit from the American Business Press in 1973. The Neal Awards were created by the American Business Press to recognize excellence in independent business publications. In the 1980s, Richman developed an interest in the natural products industry and became the editor of *Health Foods Business*, where he met Wainer. This was the beginning of a new career path that would eventually lead him to *WholeFoods*.

American Botanical Council Founder and Executive Director Mark Blumenthal, who worked with Richman during his time at *WholeFoods*, said:

Alan was my editor for many years when I wrote a monthly herb column for *WholeFoods* back in the 1990s. He was a real pleasure to work with, even when



I was late submitting my column (which was frequently). He had a very pleasant, friendly, almost laid-back manner — not one that I would normally associate with New Jersey — but he was always very patient and professional with me. And, he had a great sense of humor! I appreciated my relationship with him, one that grew into a true friendship. When he was freelancing and popped up at a natural products trade show, we would often carve out some quality time to have

breakfast or lunch. He was a truly gentle and respectful man, and I will surely miss him.

After his retirement in 2007, Richman continued to write articles for *WholeFoods* and other publications, including *The New Jersey Jewish News*. He exercised his creativity in other areas, and authored several books and developed an interest in poetry. Teaching others was important to Richman, and he served as an adjunct professor at New York University, Brookdale Community College, and Bergen Community College, and held poetry workshops on cruise ships.

Kelli Richman honored her husband's love of the written word on his memorial page, writing:

Alan was a wordsmith. There wasn't a word or phrase that didn't delight him. He wrestled with the meanings and nuances of vocabulary. He loved manipulating words to fit his needs and to get his thoughts across. As a student he didn't like poetry; as an adult, it served as another language to share his thoughts and feelings. He wrote a lot of poetry just for me. So, I will miss the banter and the genius. I will miss his thoughts on so many subjects. He was a man of letters...all 26 of them.¹

In his personal life, Richman coached youth soccer in Marlboro Township, New Jersey, for 30 years and served on the local soccer league's board. He also served on the board of trustees at Congregation Beit Shalom in Monroe Township, New Jersey.

Alan Richman is survived by his sister, Toby Richman; Kelli, his wife of 54 years; two sons, Lincoln (Shirel) and Matthew (Elisa); and four grandchildren. A funeral service was held on March 15, 2019, in Manalapan, New Jersey. HG

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Arthur Oliver Tucker III 1945–2019

By Hannah Bauman

Arthur Tucker, PhD, professor emeritus at Delaware State University (DSU), died on August 5, 2019, at age 74, after a brief, sudden illness. Tucker was a prolific author in the realm of botanical taxonomy and nomenclature, professor of botany and biology, and the co-founder and co-director of the Claude E. Phillips Herbarium at DSU. His study interests included the genus *Mentha* (Lamiaceae), essential oil production and use, and the mysterious publication known as the Voynich Manuscript.

Tucker was born in Kutztown, Pennsylvania, on June 22, 1945. After earning his bachelor's degree in biology with an emphasis on botany from Kutztown University, he completed his master's and doctorate at Rutgers University in New Brunswick, New Jersey, in 1975. He began his teaching career as a graduate student at Rutgers, then joined the faculty of DSU as a professor in 1976 and stayed there until his retirement in 2012. At DSU, he taught undergraduate and graduate courses in botany, biology, horticulture, greenhouse management, and plant physiology. Tucker also served as the greenhouse caretaker at DSU for his entire tenure.

Throughout his career, Tucker strived to make plant knowledge accessible to his students and the general public. He advised graduate students, exhibited at conferences, and held “mini-courses” on herbs for people outside of the university. In addition, he authored hundreds of consumer-oriented articles for special interest publications such as the Herb Society of America's annual *The Herbarist*, local news organizations such as *Delaware State News*, and international publications such as *Lavender Australia*.

Herbalist and author Susan Belsinger worked closely with Tucker as a co-author of two books, *The Culinary Herbal: Growing and Preserving 97 Flavorful Herbs* (Timber Press, 2016) and *Grow Your Own Herbs: The 40 Best Culinary Varieties for Home Gardens* (Timber Press, 2019). “I never met anyone [else] who could speak botanical nomenclature at nearly warp speed, off the top of his head, and who was so astute at botanical identification,” she wrote (email, August 12, 2019). “He was an intellectual and an accomplished academic, [and he] was kind, humble, and generous with his knowledge. He had an inimitable sense of humor, boundless enthusiasm for all things herbal, and curiosity for everything from plants to history and lore.”

Tucker's published work includes dozens of peer-reviewed articles, book chapters, and conference proceedings, and seven books, including *The Encyclopedia of Herbs* with Thomas DeBaggio (Timber Press, 2009) and the American Herbal Products Association's (AHPA's) *Herbs of Commerce*, 2nd edition, with Michael McGuffin, John Kartesz, PhD, and Albert Leung, PhD (AHPA, 2000). His eighth title, *Flora*



of the Voynich Codex: An Exploration of Aztec Plants, which Tucker co-authored with Jules Janick, PhD, will be published in October 2019 (Springer Publishing). In 2013, he co-authored an extensive article about the Voynich Manuscript in *HerbalGram* issue 100 with Rexford Talbert.¹

Many organizations in the herb community sought Tucker's expertise, and he was an active member of the Herb Society of America (HSA). The organization honored him with several awards, and he served as a chair on various HSA committees from 1994 to 1999. Tucker contributed chap-

ters to the International Herb Association's *Herb of the Year* books from 2006 to 2018. He also was affiliated with the Pennsylvania Horticultural Society, the Council on Botanical and Horticultural Libraries, and the Botanical Society of Washington; consulted for many publications, including the American Botanical Council's (ABC's) *The Complete German Commission E Monographs* (ABC, 1998); served on the editorial board of the *Journal of Essential Oil Research* from 1989 to 2013; and was a longtime and active member of the ABC Advisory Board.

Botanist, author, and photographer Steven Foster recalled his introduction to Tucker and how it influenced his own herbal studies. “I met Art Tucker in 1980, at age 22, when I took a Greyhound bus from Portland, Maine, to Dover, Delaware, to see his research facility at DSU,” he wrote (email, August 12, 2019). “At the time, he was one of the few scientists exploring field production for essential oil-producing plants. He was always generous with time, information, and wit. Bridging the disciplines of plant taxonomy and essential oil chemistry, Art Tucker's law was: ‘Unvouchered plant research is about as memorable as Whistler's father.’”

In his personal life, Tucker was a gifted artist in a variety of media, and his botanical illustrations have been published alongside some of his articles in *The Herbarist* and *Economic Botany*. He enjoyed gardening, and his personal garden was featured on the cover of the April 2003 issue of *Southern Living*. He also expressed himself through cooking, stencil work, painting, and sculpture, and owned a large library of books.

Arthur Tucker is survived by Sharon, his wife of 48 years; his children Melissa (Eric), Angela (Jonathan), and Arthur (Ana Paula); four grandchildren; niece; and three great-nieces and nephews. A celebration of his life was held on August 13, 2019, in Marydel, Maryland, and the Claude E. Phillips Herbarium is planning a memorial later in 2019. HG

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Publications

American Herb Association Quarterly Newsletter: \$20/yr. AHA, P.O. Box 1673, Nevada City, CA 96969.

Australian Journal of Herbal Medicine: Quarterly publication of the National Herbalists Association of Australia (founded in 1920). Deals with all aspects of Medical Herbalism, including latest medicinal plant research findings. Regular features include Australian medicinal plants, conferences, conference reports, book reviews, rare books, case studies, and medicinal plant reviews. AUD/\$96 plus AUD/\$15 if required by airmail. National Herbalists Association of Australia, P.O. Box 696, Ashfield, NSW 1800, Australia.

Medical Herbalism: Subtitled “A Clinical Newsletter for the Herbal Practitioner.” Edited by Paul Bergner. \$36/yr, \$60/2 yrs. Canada \$39/yr. Overseas \$45/yr. Sample/\$6. Medical Herbalism, P.O. Box 20512, Boulder, CO 81308.

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Wild Bergamot

Monarda fistulosa, Lamiaceae

Photograph by Stephanie Briggs, Colleyville, Texas
Captured with a Nikon D90
ISO 200, f/5.6, 1/125

Wild bergamot, also known as bee balm, is a perennial native to upland woods, thickets, and prairies throughout North America.¹ It has no relation to the bergamot orange (*Citrus bergamia*, Rutaceae). Many Native American tribes have used aerial parts of wild bergamot as an ingredient in cooking and as a medicine for the relief of bronchial issues and colds, and in topical poultices for facial lesions, headache, and stomach pain. Because wild bergamot blossoms produce nectar for bees, hummingbirds, and butterflies, they are a popular addition to gardens. Preliminary in vitro trials have studied wild bergamot's essential oil as a possible insect repellent and treatment for seborrheic dermatitis (a common skin condition that mainly affects the scalp).²⁻³ Thymoquinone, a bioactive constituent of wild bergamot and black cumin (*Nigella sativa*, Ranunculaceae), has shown antitumor effects in vitro and in vivo.⁴

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